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" *To the solid ground*
Of Nature trusts the mind that builds for aye" —WORDSWORTH

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NATURE

A WEEKLY JOURNAL OF SCIENCE

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SATURDAY, JANUARY 3, 1931

CONTENTS

The Ancient Monuments Bill

RECENT events have demonstrated beyond all question that the revision of our Acts for the protection of ancient monuments is a vital necessity. Stonehenge, the greatest of all our relics of the past, but a national possession only by private benefaction, was within an ace of permanent disfigurement and vulgarisation. It was saved only by a national appeal for funds to purchase the adjacent land. The Roman Wall, a monument no less unique and equally dependent upon its surroundings for its full significance and its appeal to the historic imagination, was and still is, in danger from an act of vandalism which would devastate one of the most characteristic stretches in its whole range. Happily, the proposals to exploit the natural resources of that area, which entailed the quarrying of some millions of tons of stone, with an illusory limitation that operations were to extend only over a brief period of years, were not allowed to pass unchallenged. The effect of the influential protest which followed the announcement of what was proposed is to be seen in the provisions of the Bill to amend the Ancient Monuments Acts which was introduced into the House of Lords by Lord Ponsonby on Dec. 3, and of which the text is now available.

In at least three directions the new Bill extends the principles of previous Acts. It enlarges the powers of the Commissioners of Works in the matter of schemes of preservation, in the range of their expenditure, and in enabling them to prohibit the exportation of ancient monuments from the country.

Under § 22 of the Act of 1913, the expression

"monument" it is laid down, "includes the site of any such monument, or of any remains thereof, and any part of the adjoining land which may be required for the purpose of fencing, covering in, or otherwise preserving the monument from injury, and also includes the means of access thereto." To a certain extent this was a compromise with the rights of private property, and in fact, in reserving to the public the means of access, together with so much land as was necessary for the purposes of preservation, as well as the site of the monument, at the time it was framed it did represent a very considerable advance in the assertion of the claims of the community as against the rights of the individual. It did no more, however, than claim the minimum essential for the protection of the structure of the monument or what remained of it. No attempt was made to safeguard its character in so far as this was dependent upon historical or natural setting.

In the case of historic buildings in urban surroundings any provision with such an end in view obviously would have been unpractical, while for other relics of antiquity, more especially, perhaps, prehistoric monuments, most of them situated in open land or isolated on moors and downs, such provision may have seemed unnecessary. It was not foreseen that a vast extension of motor traffic was at hand which would bring in its train an increase in the number of excursionists for whose entertainment and refreshment provision would be made, as well as a wider distribution of bungalow towns and suburban villadom. But the refreshment booth and the bungalow which, equally with the buildings for which the Government was responsible, menaced Stonehenge, are as nothing compared with the far graver danger from the demand for road metal, enormously increased by the provision of arterial roads and prepared surfaces for motor traffic. The quarrying at Malvern serves to show what might happen in any district which provided suitable material, and the inevitable disfigurement which threatens the countryside once guarded by the Roman Wall.

The gravity of the situation which has arisen from the development of modern social and commercial conditions cannot be too strongly emphasised. From one point of view it calls for, from another it justifies, the extension of the powers of the Commissioners of Works in dealing with ancient monuments. It is proposed to enact that the Commissioners may frame schemes for preserving the amenities of ancient monuments and that such schemes may provide for prohibiting or restricting building works, the felling of trees, quarrying and excavations, and for otherwise restricting the user of land within the controlled area. Further, in the definition of an ancient monument for this purpose and in so far as affects the acquisition, guardianship, receipt of voluntary contributions towards maintenance, and the transfer of ancient monuments, the term is extended to include any land comprising or adjacent to an ancient monument which, in the opinion of the Commissioners or the local authority, is 'reasonably required for the purpose of maintaining the monument or its amenities, or for providing or facilitating access, or for the exercise of proper control or management.'

It will be seen that under the provisions of the Bill it is proposed to give the Commissioners wide powers. Not only may they prohibit any action of the owner or his representatives in the vicinity of the monument which would be likely to be injurious or unsightly, but according to their interpretation of what constitutes the amenities of the monument, they themselves may determine the area to which that prohibition extends. In view of the past record of the Commissioners in the action they have taken in relation to ancient monuments, it is improbable that their interpretation of their powers under these provisions will be such as to be regarded as unduly harsh. The rights of the owner, however, are now to be protected by the provision that a preservation scheme may provide for compensation to persons whose property is injured by the scheme. When no such provision for compensation is made, objection to the scheme may be raised, within three months of the date of the order confirming it, by any person so affected. In that event the scheme shall cease to have effect two years from the said date unless it is confirmed by Parliament. Thus the Act would ensure a period during which the monument would be fully protected while the case was argued on either side. Expert opinion would obtain a hearing, and it may be assumed the public would be informed through the Press of the merits of the case. The action of Parliament eventually would ensure that a weight of opinion in favour of the scheme would prevail. By a similar provision for objection in the case of a preservation order which places the monument under the protection of the Commissioners, the owner is placed in a more favourable position, as under the existing Act there is no opportunity for appeal until the Bill to confirm the order is before Parliament.

The Bill also proposes to enlarge the powers of

the Commissioners in the matter of finance Unlike the Ancient Monuments Acts of certain other countries, such, for example, as Switzerland, the British Acts have made no adequate provision for the maintenance of ancient monuments At present the powers of the Commissioners in respect of preservation and upkeep are confined to those monuments of which they are owners by transfer or of which they have been constituted the guardians by a deed executed by the owners The powers of local authorities are wider, for they may, if they think fit, bear the cost or contribute towards the cost of preserving, maintaining, and managing monuments of which they are not the owners and guardians, provided the monuments are in or near the area for which they are the authority These powers, however, it will be noted, are permissive only The responsibility for a monument which is the subject of a preservation order, but of which the Commissioners or the local authority have not been constituted owners or guardians by deed, falls upon the owner , but he is under no compulsion to maintain The results in some cases have been disastrous

To some extent the difficulty is met under the provisions of the new Bill The powers of the Commissioners and local authorities are enlarged in the case of monuments of which they are guardians It is proposed that they should now be empowered to incur expenditure on excavating and examining such monuments , while in the case of monuments of which the Commissioners are not owners or guardians, they will be empowered to undertake and pay for "work" While it may be presumed that such authorisation would not cover the cost of maintenance, it could be made to cover urgent work essential to preservation

It will be noted that the work of excavation is here added to the permissive powers of both the Commissioners and local authorities The Bill also gives the Commissioners power to enter upon any land believed to contain an ancient monument and excavate for purposes of examination, except that if that land be occupied in connexion with a dwelling-house, or in private ownership, the consent of the occupier or owner is required

A further provision as regards finance would empower the Commissioners to bear the expense in whole or part incurred by an authority through preserving the amenities of an ancient monument in carrying out a scheme under the Town Planning Act, 1925

As a final measure of protection, it is proposed that the Commissioners may by order prohibit the export from Great Britain of any monument or any part of it This order will continue in force until any order is made revoking it It shall also be open to a local authority to obtain an injunction against the exportation of an ancient monument by application in the county court of the area in which the monument or any part of it is situated

The faulty definition of a monument, which specifically stated that it was a 'structure' or an 'erection', is changed An amendment was desirable here in order to bring within the class of 'ancient monuments' remains of archæological interest which could not be regarded as either "Monument" will now include "any building, structure, or other work, whether above or below the surface of the land and any cave or excavation"

Our ancient monuments have suffered grievously in the past from lack of adequate attention, and many a priceless relic has vanished or has been mutilated, both before and since the passing of the Act of 1882, through public apathy or official indifference There are signs that a healthier public opinion, more fully alive to the significance of the ancient monument, is on the increase If the Bill now before Parliament becomes law, as it should, and with no undue restriction laid upon the authorities whose duty it will be to administer it, the nation will be one stage nearer the complete realisation that in relation to the material evidence of the past, to day is at best the trustee of to morrow

The Twilight of Selenium

The Selenium Cell its Properties and Applications By George P Barnard Pp xxix + 331 (London Constable and Co , Ltd , 1930) 35s net

IT is a remarkable fact that in spite of the keen interest displayed in selenium ever since the discovery of its response to light fifty-eight years ago, no complete treatise on its properties has appeared in English until now Students have had to rely on the small German handbooks of Ruhmer and of Ries, or the compendium, "Il Selenio", published by Bianchi in 1919 If Mr Barnard had done no more than compile his 50 pages of excellent bibliography he would have conferred a considerable benefit on the scientific public But his book does much more than that

The study of the properties of selenium has reached a peculiar position The reaction following upon the earlier claims of inventors which failed to materialise has been so severe that the excellent work of more recent days has had to disguise itself,

so to speak, under pseudonyms Thus, television by means of infra red rays and selenium is called '*noctovision*', and a powerful London company for the manufacture and utilisation of selenium cells is known under the name of 'Radiovisor' There has never been a time at which more selenium cells were constructed and used, or when such rapid and solid progress was made in the study of their properties But few dare confess to it It is the twilight of selenium, the eclipse of the 'moon element'

When, in 1872, the light sensitiveness of selenium was discovered, Mr Shelford Bidwell said at the Society of Telegraph Engineers "Mr Preece has told us that by the aid of the microphone the tramp of a fly can be heard, resembling that of a horse walking over a wooden bridge, but I can tell you something which, to my mind, is still more wonderful that by the aid of the telephone, I have heard a ray of light fall on a bar of metal"

Everyone would have expected that after such an introduction the combined efforts of the scientific world would have sufficed to unravel the secrets of the marvellous substance which presented such a phenomenon Yet, fifty five years after, Prof Gudden, who has spent a lifetime in studying photoelectric phenomena in crystals, says "It is as hopeless to expect to understand what happens in selenium from the observation of selenium cells as it would be to determine the laws of vibration from the investigation of a creaking hinge"

Prof F C Brown is one of those who spent many years investigating large single crystals of selenium, but his work has not yet reached a satisfactory conclusion Gudden and Pohl have at all events, established one basic fact, namely, that in the insulating red form of selenium the effect of light upon the conductivity is both instantaneous and linear, though reckoned in micro micro amperes These red crystals have, according to Kyropoulos, a refractive index so high as 3 5 and obey Maxwell's law of refraction Much of the work on selenium of the next fifty years will no doubt be done on red selenium

When the D C conductivity of a substance is to be studied, we must, unfortunately, have electrodes, and selenium with electrodes constitutes a 'selenium cell' It should not surpass the ingenuity of our physicists to make the monoclinic crystals of conducting selenium arrange themselves in a regular and reproducible order, and to find an electrode, say of carbon, which has no chemical effect upon the substance We know that the square root law of light action is obeyed at faint illuminations down to very low values, and that is some foundation

There used to be a slogan in the Cavendish Laboratory at Cambridge when anything difficult had to be undertaken "Do it with selenium!" (pronounced, in defiance of Greek etymology, "selenium"), and Mr Barnard certainly enumerates an imposing array of results achieved by the 'creaking hinge' Fire and burglar alarms, automatic machines for counting stamp cancellations and even carcases, street lighting and train control, the mechanical estimation of fog and smoke density, and the control of camera shutters, are some of the successful applications of selenium Cox's magnifier of cable signals is fully described, as is Symonds's ingenious device for counting interference fringes This and the optophone could not possibly function with any form of photoelectric cell

When we come to the applications of intermittent light we are on less difficult ground, for all considerations of the zero in the dark can be eliminated or disregarded The only element that matters is the amplitude of the response

It has been found that selenium responds to notes of a frequency of 12,000 hertz It is therefore capable, in spite of its 'lag', of following the whole gamut of the notes used in music Theoretically, its response ought to vary inversely as the pitch, and a correction would have to be applied to make the higher notes stronger This would be inconvenient but for the fact that every reproducer devised so far must be corrected in one sense or the other Usually it is the lower notes that want strengthening The correction is the easier for the fact that there is plenty of current to spare Prof Thirring showed recently that selenium gives from 1000 to 1,000,000 times as much response as any photoelectric cell

A most valuable feature of this excellent book is the collection of chemical, optical, and electrical constants of selenium Everyone will naturally turn to these tables for information as to the resistivity, only to be told that it lies somewhere between 10^5 and 10^{10} ohms/cm ^{3} The figure 10^6 given by Siemens might have been quoted as an approximate practical guide E E F D'A

Immunisation of Plants

L' immunità nelle piante Per D Carbone e C Arnaudi (Monografie dell' Istituto Sieroterapico Milanese) Pp xii + 274 + 3 tavole (Milano Istituto Sieroterapico Milanese, 1930) 25 lire

DISEASE in plants is a subject which sooner or later brings to the mind of initiated and uninitiated alike the possibility of assisting our crop and ornamental plants with some of the more

recent discoveries in human and animal pathology which are in daily use for reducing the ravages of disease Realising that the results of the simplest operations in animal and vegetable therapeutics are not exactly similar, and that the structure and functions of the body parts of animals and of plants have little in common, it is encouraging to find that the more complex application of serum and vaccine therapy to plants is being continuously and seriously studied in Italy by the joint work of Dr D Carbone and Dr C Arnaudi, who, in this latest monograph from the Institute of Serotherapy of Milan, have reviewed the whole subject of immunity in animals and plants and the practical applications of the knowledge gained by their work

In England the published opinions of some of our prominent physiologists and plant pathologists show that there is little sympathy with the view that disease resistance can be secured in plants by methods which are successful in animal pathology, it being asserted that in plants a reaction to disease is localised and not found, as generally in animals, throughout the body, moreover, there is no blood stream by which anti bodies can be distributed throughout the plant It is further pointed out that in plants—and this, of course, applies to agricultural crops—new organs (roots, branches, flowers, seeds) are being continually produced, necessitating the rapid spread of the immunising factor, and unless there is some prospect that acquired immunity will be transmitted to the freshly developing organs, the study of serum and vaccine therapy in plants is likely to receive meagre support Scientific workers, however, are not daunted by difficulties, and certainly not by those which are only suggested It is with a feeling of admiration, therefore, that we note these authors have 'nailed their colours to the mast', for on the cover of their work appear some words of Sir J C Bose "Animal life finds an echo in the vast inarticulate life of plants The vital processes of the one and of the other are guided by identical laws"

The title of the book conveys no indication that it is only slightly concerned with the natural immunity of plants and chiefly with the serotherapeutical aspect Prof S Belfanti, in his preface, introduces this monograph as one result of a plea for unity and interchange of ideas which he made at the Perugia Congress of Italian Microbiology in 1929 He bewails the splitting of microbiology into autonomous branches, and suggests physiopathology as a science comprising the study of the conditions which determine the common pathological state of all living beings

The terminology of animal immunity is dealt with in the first thirty pages, and examples are given when each definition of a term is discussed A special section is devoted to the immunity reactions of certain of the lower animals, since these are not so far removed from plants as are the vertebrates

An insight is next given of the congenital immunity naturally present in plants, touching on the subject of specialisation of parasitism, Dr Arnaudi criticises adversely the modern tendency to multiply the number of biologic forms of a parasite An attempt is not made to give a complete review of the literature, and discussion of certain work is avoided when this is highly specialised and does not, in the author's opinion, assist in obtaining a general view of the subject It is somewhat surprising, however, that no mention is made of well known investigations on the grafting of immune and susceptible plants, since the authors have been deeply concerned with the possibility of transportation of immunity factors in the sap Very little original work is included in this first discussional part of the monograph, a method of technique, however, is given for the culture *in vitro* of plant tissues and the maintenance of botanical sections alive for about a month Dr Arnaudi thinks that eventually this will enable the phases of symbiosis or of infection and the corresponding cell reactions to be followed exactly

Chap III, on acquired immunity in plants, begins Part 2 of the book Some few facts are brought forward in an attempt to show that phenomena of plant and animal resistance to disease are not altogether dissimilar Dr Arnaudi describes the work of others and one of his own experiments with *Bacterium tumefaciens* on geraniums when dealing with resistance to superinfection He summarises the results of eight experimenters with vaccination of plants and details two of his own vaccination studies Complete immunity as a result of vaccination is claimed in begonia and kidney bean from *Botrytis cinerea*, in orchids from *Orcheomyces* spp and *Rhizoctonia repens*, and in bean from *Bacillus carotovorus* In other cases a degree of resistance is gained but the period of duration of the immunising effect is short, varying from one week to one month The mechanism and technique of vaccination are discussed A section on acquired passive immunity includes description of an experiment in which galls on geranium were made to shrivel up by keeping the cut stems in a liquid containing

anti-*B tumefaciens* serum obtained from a rabbit By the same method a fresh infection by the parasite was made to fail

In the ninety pages of Chap iv, which delves deeply into the relation of animal immunity to that of plants, the whole subject of the presence or absence in plants of pseudo antibodies and the various antibodies known to human bacteriologists is exhaustively dealt with by Dr Carbone Knowledge accumulated by other workers is given *in extenso*, and original experiments are detailed which must have required truly laborious technique An example is that involved in adapting and performing the complement fixation test It is not shown that plants do or do not produce antibodies

The final chapter, entitled " Phyto Immunity in Practice ", is somewhat disappointing, as are also the conclusions arrived at It appears that in our desire for crop plants resistant to disease, we are to rely rather on the work of geneticists than on being able to confer acquired immunity Moreover, the reader is left with the idea that an enormous amount of arduous work has been performed and much has been written with insufficient results to warrant the inclusion of a chapter with this title There can be no doubt of the great ability of these investigators, however, who are to be congratulated on having accomplished much in laying a foundation for future work W M WARE

Alchemical Manuscripts

Union Académique Internationale Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century By Dorothea Waley Singer, assisted by Annie Anderson and Robina Addis Vol 2 Pp viii + 329 755 (Brussels Maurice Lamertin, 1930) 10 Belgas

THE publication of a second part of Mrs Singer's catalogue of alchemical manuscripts enables us to form some idea of its usefulness as a guide to the *Corpus Scriptorum Alchemistarum*, a usefulness which will be materially enhanced by a promised third part containing indexes of names, places, and first lines It would be hard to exaggerate the importance of this work to the historian of scientific thought in western Europe, we are here put in possession of a key to the materials from which the story of the development of alchemical theory can be written Up to now, no historian of chemistry except Kopp, and in a lesser degree Berthelot, has gone to the manuscript sources for his information, all of them, when they have not copied one from another, have aimlessly turned a few pages of the printed texts and extracted some sentences from them to small profit

The literature of alchemy was collected in the seventeenth century by Zetzner in six closely printed volumes and later by Manget in two folios—mainly from printed sources The earliest treatises have in the main escaped printing down to our own days, while those of the early texts reproduced are incredibly corrupt by the accretion of notes and interlineations and by accidental omissions But no thorough revision of the classics of Latin alchemy will be possible until the scholars of France and Italy have followed the example here set In the meantime, any student of philosophy, equipped with some knowledge of the medieval Aristotle, will find here a rich field open to him

The catalogue is arranged in the order of the historic development of alchemical thought, first of treatises of Byzantine or Hellenic origin such as the " Turba Philosophorum ", the " Emerald Table ", and other treatises ascribed to Greek authors, real or apocryphal, then to Arabic authors, to Latin authors in prose, to anonymous treatises, to the large body of alchemical verse, to chemical crafts, and to receipts of all descriptions The named treatises were included in the first part, the remainder are here given and their study throws an interesting light on the processes of chemical technology in the Middle Ages One does not see how this arrangement can be improved upon, but it must not be allowed to mask the fact that alchemical theory in western Europe was entirely Arabist in its origin and growth Chemical technology is purely Byzantine and Hellenic, but it was altogether divorced from theory, and the " Turba " is never quoted by any writer in the first century and a half of alchemical literature But though Greek thought had no direct action on Latin writers, it was the ultimate source of Arabic alchemy as regards the theory of metals, the elixir of life being apparently of Chinese origin No doubt a few Byzantine adepts found their way into the west—Roger Bacon mentions a Greek he had known, and there is the still earlier case of the Jew of Bremen

The story of translation from the Arabic begins with Robert of Chester in 1144, Plato of Tivoli and Hugo Sanctallensis, and goes on to Gerard of Cremona, who before his death in 1187 translated three classics of alchemy—two of them only printed in our own time, by Berthelot and the writer A number of treatises were translated

before the middle of the thirteenth century, as shown by the quotations from them in the "Speculum Naturale" of Vincent of Beauvais (1245), the alchemical writings of Roger Bacon ending 1267, and the writings of Albertus Magnus on minerals and the "Speculum Astronomicum" St Thomas also accepts the scientific possibility of alchemy The series of philosophic writers on alchemy closes with Arnold of Villanova at the end of the thirteenth century Two expository works of some value as accounts of current theory were written in the first half of the fourteenth century—the "Margarita Novella" of Petrus Bonus and the "Quintessence" of Johannes de Rupescissa—but no new ideas are to be found in them, the developments of the Aristotelian theory of matter had been exhausted and the pursuit of the transmutation of metals had been abandoned, not as impossible but as impracticable The fifteenth century brings in a spate of tracts, all with high-sounding claims, reiterating the old formulæ and clothed in the old mystification of language

It is impossible to rate too highly the unwearying industry of Mrs Singer and her helpers, they have searched and almost re-catalogued not only the great collections of Sloane and Harley in the British Museum, of Digby and Ashmole at Oxford, but also every corner of every library, great or small, in Great Britain, and have revealed a scarcely suspected wealth of manuscripts When their provenance is examined and tabulated some interesting results may appear It would seem that the earliest centre of alchemical activity was in northern Italy, that from there it spread to the south of France, thence to Paris, becoming common in England in the fourteenth century, as witness the "Canon's Yeoman's Tale" of Chaucer Its progress is marked by the Act of 1403 making it illegal—alchemy had become a shield for coiners of false money The Act, however, was powerless to stay the flood of students and treatises—some of them voluminous like those ascribed to Ramon Lull, which first appear in 1443 (translated from a non-existent Catalan original) There are, too, a number of official licences to practise alchemy on record, and more remarkable still, three Royal Commissions to inquire into its possibilities as a means of paying the King's debts—the last a very strong one consisting of four bishops and a number of high officials It would be interesting if Mrs Singer, who has ferreted out of the Record Office some alchemical tracts, could come upon the reports of these Commissions Licences and treatises come to an end in England at the last quarter of the fifteenth century, 1476 for the licences, 1471 and 1477 for the treatises of Ripley and Norton Commerce was offering a more certain road to wealth than alchemy

In the thousands of extracts of more or less barbarous Latin in badly written, badly spelled and contracted manuscripts here printed, it is not to be expected that there should be no doubtful readings, but speaking with no inconsiderable experience of medieval hands, I can say that the work as a whole would do credit to an expert palæographer and bibliographer It is the sort of work that only an enthusiast would undertake, and it betrays the hand of an amateur only in the desire for completeness which has led Mrs Singer to give us lists of the manuscripts of the "Canterbury Tales" and such like works which have been made the subject of intensive study elsewhere Mrs Singer and her assistants have earned the hearty thanks of all who are interested in the history of scientific thought ROBERT STEELE

Gumbotils and the Pleistocene Succession

Iowa Geological Survey Vol 34 *The Pre Illinoian Geology of Iowa* By George F Kay and Earl T Apfel Pp 304 + 3 plates (Iowa Iowa Geological Survey, 1929)

SINCE the middle of the last century, certain sands and gravels which occur embedded in glacial boulder clays have been interpreted as accumulations of genial interglacial periods A similar construction has been placed upon the peats and forest trees which over the same time have been derived at intervals and from widely separated localities in these layers in northern Europe and North America In more recent times the importance of deeply weathered boulder-clays as indicators of interglacial conditions has been frequently stressed, as by A Jentzsch and C Gagel in Germany, and by A Penck and E Brueckner in the region of the Alpine glaciation These weathered layers, however, have never had quite the same emphasis placed upon them in connexion with the recognition and extensive mapping of the interglacial horizons as by Dr G F Kay and his colleagues on the Iowa Geological Survey during the last ten years or so It has to be admitted that the effectiveness of the old methods is definitely limited, for the sands and gravels are impersistent and of diverse origin, while the peats and trees are few and fragmentary and of local occurrence only The weathered clays or 'gumbotils', on the other hand, are of wide extent and considerable

thickness and can be mapped as stratigraphical units

The gumbotil, to use the term introduced by Dr Kay, is a grey to dark coloured clay, very sticky—'gumbo' is a sticky clay—destitute of lamination and stratification It is tenacious when dry and breaks with starch like or polyhedral cracks when wet It represents the thoroughly leached and oxidised boulder clay resulting from the chemical weathering of the till on wide, flat surfaces of country during interglacial periods, aided by the action of frost, wind, sun, and animals and the organic acids arising from the growth of vegetation The iron, silica, colloidal clays, and simpler colloidal silicates have been carried downwards from the surface and the calcareous materials have been leached out, though to a shallower depth than that reached by the oxidation In this way, the percentage of alumina in the surface layers has increased at the expense of the other constituents

From the point of view of Pleistocene geology, the State of Iowa is probably the most important in North America It lay within the influence of the Labrador and Keewatin ice sheets, and, perhaps partly because of this position, served during the nineties of last century as the battle ground where the idea of the multiplicity of the glacial period definitely obtained the victory in North America The successive drifts, denoted the Nebraskan, Kansan, Illinoian, Iowan, and Wisconsin (separated by the interglacial horizons of the Aftonian, Yarmouth, Sangamon, and Peorian), are all to be found within its borders, while its records of the inter glacial periods are probably fuller, better preserved, and have been studied in more detail than in any other part of America

The mapping of the gumbotils by Dr Kay and his colleagues during the last eighteen years has added greatly to our knowledge of the character and distribution of the different drifts and the interglacial layers The Nebraskan drift, averaging 100 feet in thickness, is thought to have covered originally the entire State, not excluding its north-east corner, formerly contained within the 'Driftless Area', where isolated patches of an old drift have been observed on the remnants of the Pre Pleistocene peneplains The Kansan drift, about 40 feet thick, covered the whole State, except the so called 'Driftless Area' The Illinoian drift occurs in the south-east, the Iowan drift in the north-central third, and the north west The Wisconsin drift, characterised by its fresh and youthful features and immature drainage, is restricted to the north west central part of the State Plate II of this Report gives a very welcome map of the areal distribution of the several drifts as determined by the old sections and by the new ones exposed in the making of more than 15,000 miles of graded roads

The Aftonian and Yarmouth interglacial periods, according to the authors, are each to be measured by hundreds of thousands of years The steep-walled and drift buried valleys, which are distinctive features of the bedrock topography, are thought to have been cut, not in preglacial times as is generally held, but chiefly in Aftonian times The depth of the Aftonian erosion is locally so great as 400 feet or more, though figures of 200 feet are more common

The belief in such prolonged interglacial intervals seems to be counter to the trend of thought on the eastern side of the Atlantic, where the tendency is to curtail the length of the Glacial Period

The average thickness of the Nebraskan gumbotil is 8 feet, of the Kansan, more than 11 feet, and of the Illinoian, 3 feet The Iowan and Wisconsin tills have no gumbotils

A description of the drifts and their gumbotils forms the bulk of the present book, while one chapter (iii) is devoted to a complete and invaluable summary of the history of investigation and classification of the Pleistocene accumulations of the State It contains a restatement of the case for the retention of the Iowan glaciation as a separate glaciation, a view which has been repeatedly questioned by Leverett, partly from field studies, partly from the difficulty of equating five glaciations in North America with four glaciations in Europe

The report is well illustrated with maps and pictures The usefulness of the photographs, some of which are by no means clear, would have been enhanced by the insertion of marginal names and lines opposite the different horizons they portray

Our Bookshelf

Death Customs an Analytical Study of Burial Rites By Dr E Bendann (The History of Civilization Series) Pp xiii+304 (London Kegan Paul and Co, Ltd, New York Alfred A Knopf, 1930) 12*s* 6*d* net

MISS BENDANN has brought together the evidence bearing upon the conception of death among the peoples of four areas—Australia, Melanesia, northern Siberia, and India The object of her analysis is to demonstrate the varying effect of the character of the concept upon death and burial customs For this purpose, under the headings 'similarities' and 'differences', various beliefs, rites, and customs,

such as the origin of death, causes of death, disposal of the dead, dread of the spirit, mourning, taboo, the special function of women in mourning rites, and so forth, are examined in detail She deals " rather cavalierly ", as Dr Goldenweiser puts it in his preface, with Spencer, Tylor, Frazer, Rivers, and others, but whether her criticism is also judicious, it may be left to the reader to decide Her own conclusion is that " we have no authority to speak of a uniform line of development which carries man from one stage to another ", while certain kinds of parallel sequence which make for an advance in cultural development are thought to be due " not so much to historical causes as to psychological ones " Thus the author's final position represents a compromise between the evolutionary point of view and that of the historical school The death complex is regarded as in part composed of certain inherent psychic features, and the only elements which are held to be exclusively characteristic of the death situation are mourning customs as such and the ideas in regard to the life after death

The Rôle of Research in the Development of Forestry in North America By I W Bailey and H A Spoehr Pp xiv + 118 (New York The Macmillan Co, 1929) 6s net

THE primary object of this book is, the authors state, to determine how and to what extent certain categories of the natural sciences may be of service to sylviculture during different stages of its development In connexion with the sciences, the authors consider that there are two distinct methods of investigating complex biological phenomena - one the extensive observational method of the descriptive sciences, and the other the intensive analytical method of the basic experimental sciences

The subject is dealt with under the heads Agriculture as contrasted with sylviculture, ie research and its application in sylviculture as contrasted with agriculture and medicine, present status of forestry in the United States, existing agencies for descriptive and empirical investigation in forestry, can research in the basic experimental aspects of forestry be developed and handled adequately by existing agencies, and, finally, new agencies required for research, particularly in the fundamental physiological and ecological aspects of forestry There is much in this little book which should appeal to a wider circle of foresters than those in North America for whom it is especially written, the authors may be congratulated on a most useful and interesting piece of work

Essays and Addresses Sociological, Biological and Psychological By a Surgeon Pp xiii + 277 (London H K Lewis and Co, Ltd, 1930) 10s 6d net

THIS book is a collection of lectures, addresses, and articles published during the last twenty years, recording thoughts and opinions on various social problems approached from the biological point of view Although the individual chapter subjects vary considerably, three fundamental principles are apparent throughout the volume They are the necessity for a fuller recognition of the influence of evolution in all human affairs, the importance of hereditary constitution, and the need for a closer application of biological principles in the attempt to solve social problems The conclusions put forward are not concerned with theories and principles alone In a discussion of some causes of racial decay, a practical method of national stocktaking is suggested, a means of ascertaining quality as well as quantity As the considered opinions of one who combines a scientific training with a close study of racial welfare requirements, and who is held in the highest esteem in his own profession—the authorship is but thinly veiled—this book merits the attention of all whose duty it is to guide legislation as applied to the improvement of national health

The Archæology of Roman Britain By R G Collingwood (Methuen's Handbooks of Archæology) Pp xvi + 293 + 8 plates (London Methuen and Co, Ltd, 1930) 16s net

THIS is a book which was badly needed indeed The literature of Roman Britain is highly specialised, difficult of access, and extremely technical Mr Collingwood has aimed at supplying the elementary but fundamental knowledge which is essential in entering upon the study of Romano British culture Still more will it help those who, not being specialists, wish to follow intelligently the reports of results which are being achieved season by season on a number of sites up and down the country Each of the different classes of antiquities is here described in detail—roads, camps, forts, towns, villas, temples, native settlements, and so forth Especially valuable are the chapters which deal with the pottery, both Samian and coarse ware The chapter dealing with the latter is of interest not merely to the beginner but also to the expert, for in it Mr Collingwood has made a first attempt to form a series of nearly a hundred dated types The very full illustration from drawings by the author, both in this chapter and in that dealing with brooches, will be found invaluable Mr Collingwood has been at great pains to give every assistance to the student

The Truth about Cancer Published for the British Empire Cancer Campaign Pp xv + 124 (London John Murray, 1930) 2s 6d net

THE various committees of the British Empire Cancer Campaign which have been concerned in the preparation of this small book for the general public have succeeded very well in a difficult task The ' man in the street ' is perhaps not much concerned to understand the nature of malignant tumours, but he will certainly be less liable to die of cancer if he will absorb the broad facts about its causation and treatment which are set out so plainly here More stress might have been laid on prevention, on the special efficacy of tar and soot in causation, on the lessons to be learned from the fact that industrial labourers have much more cancer than professional men The account of the early symptoms is particularly well done, and should bring many people to their doctors at a time when a cure is reasonably within range

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fluorescence of Mercury Vapour under Atomic and Molecular Absorption

IT is familiar that mercury vapour under pressures of a few centimetres of mercury gives a green fluorescence when excited by wave-lengths near the resonance line λ2537. Proceeding away from the resonance line, I have observed the fluorescence with wave-lengths so long as λ3450, though at this extremely low excitation dense vapour is needed. This note deals with excitation near the resonance line.

The fluorescence is much brighter near the entrance than elsewhere, due to rapid exhaustion of the most effective constituents of the exciting radiation. I have emphasised that there is a *discontinuity of intensity* as we proceed along the beam, and this is attributed to the existence of two kinds of absorption, atomic and molecular. Atomic absorption is dominant at first. The radiation capable of this kind of absorption is limited to about 0.05 A. on either side of the resonance line. I call the fluorescence from it the *core* effect, and the much weaker fluorescence, due to outlying radiation, the *wing* effect. The latter does not suffer rapid extinction as the beam traverses the vessel. Some continental physicists who have been interested in the question are unable to accept this point of view, and consider the apparent discontinuity an illusion, regarding the fluorescence absorption as molecular in every case.

A full discussion will be published later. I write now to record that the reality of the distinction between the wing and the core effect is confirmed by observing what happens when a suitable addition of hydrogen gas is made to the mercury vapour. It is easy to adjust the hydrogen admixture so as to extinguish completely the core effect, leaving the wing effect almost unaltered. I have obtained the latter with hydrogen pressures so high as 10 cm.

RAYLEIGH.

Terling Place, Chelmsford,
Dec. 16.

Evidence for a Stellar Origin of the Cosmic Ultra-penetrating Radiation

WHILE in former years all observers were agreed that the sun does not contribute any noticeable amount to the total intensity of the cosmic ultra-radiation, the increase in the sensitivity of the apparatus used within recent years, and the increase in the number of observations made at different stations and under different experimental conditions, makes it possible to investigate once more whether the influence of the sun is altogether negligible.

Very accurate and trustworthy registrations of the cosmic radiation have been carried out with Prof. G. Hoffmann's high pressure ionisation chamber at Muottas Muraigl (2456 m. above sea level) in the Engadine. These measurements show, beyond any doubt, that the average intensity of the radiation is somewhat greater in daytime than during the night. G. Hoffmann and F. Lindholm[1] give the average difference between day and night intensities as 0.12 mA., ~0.0125 ions per c.c. per sec. while the apparatus was unscreened from above, and 0.04 mA., ~0.0042 *I* with a lead screening of 6 cm. and 9 cm. thickness. (The letter '*I*' always denotes "ions per c.c. and sec.".) F. Lindholm,[2] with the same apparatus, found from longer series of observations (8 months) the values in the accompanying table (see Table 6 of his paper).

In Hoffmann and Lindholm's apparatus a compensation current of one milliampere corresponds to an ionisation of 0.104 *I*. Therefore the total intensity of the ultra-radiation with the apparatus unscreened from above was about 2.50 *I* at Muottas Muraigl.

The difference between day and night intensity can be taken, provisionally at least, as the actual intensity of the solar penetrating radiation. One can see at once that at Muottas Muraigl, 2456 m. above sea level, about one-half of this solar radiation component is able to penetrate through 10 cm. of lead. This component is therefore far more penetrating than the gamma rays from radioactive substances. If we assume that all of the above mentioned 0.011 *I* is of solar origin, we can compute the absorption coefficient in lead μ_{Pb} (it will suffice to take the case of perpendicular incidence) from the equation

$I = I_0 e^{-\mu_{Pb} d}$ taking $I_0 = 0.011$, $I = 0.0058$, and $d = 10$ cm.,

thus we obtain $\mu_{Pb} = 0.064$ cm^{-1} and the mass absorption coefficient $\left(\frac{\mu}{\rho}\right)_{Pb} = 5.7 \times 10^{-3}$ cm^2/gm.

This value is almost exactly equal to the mass absorption coefficient value of the total cosmic radiation at the same altitude ($(\mu/\rho)_{Pb} = 6.3 \times 10^{-3}$ cm^2/sec. as found by Büttner on the Eiger glacier 2.3 km. above sea level).[3] If we assume that part of the (0.011 *I*) difference between day and night values with unscreened apparatus is due to an increase in the average content of radium emanation and its products in the air during daytime, then we should get an even more pronounced hardness of the solar penetrating rays, that is, a smaller value for their mass absorption coefficient. Therefore we are justified in concluding that *the sun emits penetrating rays of at least the same penetrating power as the well-known cosmic ultra-radiation. The total amount of the solar penetrating rays (at 2456 m. above sea level) is about one-half per cent of the total intensity of the cosmic radiation, as it is seen from the accompanying table.* Of course, one might think it possible to explain the increase in the total radiation during daytime as due to an indirect influence of the sun (that is, an increase in the scattering of the ultra-rays by the heating of the atmosphere during the day). In this case, however, one would expect that this scattered radiation, represented by the difference between the day and night values, would be much softer than the general cosmic radiation; but this is in contradiction to the experimental results analysed above.

Recent observations of R. Steinmaurer[4] on the summit of the Sonnblick (3100 m. above sea level) in the summer of 1929, made with three different instruments (two of the Kolhörster double loop electrometer type and one of the Wulf–Kolhörster type), also show clearly that the total ultra-radiation in daytime is slightly higher than at night; the difference amounts to about 0.7 per cent (0.06 *I*, average difference for the three forms of apparatus mentioned above, the total intensity on the Sonnblick being about 8.7 *I* with the screening open on the top). The increase of radiation was also observed with apparatus screened with 7 cm. iron all around, but the number of these observations on the Sonnblick is not sufficient for quantitative calculations. It may be mentioned that even in the old observations on the summit of the Obir (2000 m. above sea level), made by V. F. Hess and M. Kofler,[5] the solar influence is noticeable (the total intensity of the ultra-radiation plus earth radiation during the day being 11.11, during the night 11.09 *I*, in the average for 13 months), although at that

time the apparatus were not screened from the earth radiation The difference of 0 02 I was—at that time—considered as practically amounting to zero

Observations with apparatus of the Wulf- or Kolhörster type for shorter periods (like those of Kolhörster-v Salis on the Jungfraujoch, on the Mönch, and of Buttner at other places in the Alps) naturally do not show the influence of the solar component of the ultra-rays, on account of the lesser degree of accuracy of the means, therefore Corlin,[6] using the observations on the Mönch and the Zugspitze, came to negative conclusions as to the solar influence From the data given below it is quite safe to conclude, according to the most accurate and most numerous observations at present available, that *the sun contributes an amount of about 0 5 per cent to the total intensity of the cosmic ultra radiation at 2 5 km above sea level The penetrating power of the solar ultra rays is at least as great as that of the total cosmic radiation* There is no doubt that this solar component of the ultra radiation is also present at lower levels, on account of its very small absolute intensity it will, of course, be far more difficult to prove its existence in these levels An analysis of the very accurate registrations of the total radiation by Hoffmann and Steinke in Königsberg and in Halle in this direction might be successful

Period	Number of Days	Armour open above		
		Mean Values		Difference (Day—Night)
		Day	Night	
1928 January–March	(32)	24 46 mA	24 34 mA	0 12 mA = 0 0125 I
1928 June, July, October	(39)	23 98 ,,	23 88 ,,	0 10 ,, = 0 0104 I
1929 January–February	(11)	24 68 ,,	24 59 ,,	0 09 ,, = 0 0094 I
		Weighted average difference		0 011 I

Period	Number of Days	Armour closed (10 cm lead screening all around)		
		Mean Values		Difference (Day—Night)
		Day	Night	
1928 March	(2)	19 54 mA	19 50 mA	0 04 mA = 0 0042 I
1928 July	(8)	19 21 ,,	19 17 ,,	0 04 ,, = 0 0042 I
1929 February	(6)	19 46 ,,	19 38 ,,	0 08 ,, = 0 0084 I
		Weighted average difference behind 10 cm lead		0 0058 I (ions/c c /sec)

If the sun, as the fixed star nearest to our planet, emits rays of about the same qualities as the total cosmic penetrating radiation, one cannot but assume that all fixed stars are sources of a radiation of similar qualities The sun being a relatively old star of the yellow dwarf type may, of course, be expected to yield far less total quantity of the ultra penetrating radiation than, for example, the younger giant stars Naturally, the ultra penetrating rays which we observe can only come from the outermost layers of the stars, since they are not able to penetrate material layers of more than a few hundred metres water equivalent

It is not possible, at present, to say more about the nature of these stellar ultra rays whether they are electrons or protons accelerated in cosmic electric fields, or indeed photons (quanta) created by atomic mass shrinking or annihilation processes This hypothesis of a partly stellar origin of the ultra penetrating cosmic radiation does not necessarily exclude the possibility that another part of this radiation is created in interstellar space by the formation of certain elements out of hydrogen, according to Eddington's and Millikan's ideas, although the principle of minimum hypothesis would rather induce us to try whether the stellar origin hypothesis, based on the experimental evidence of the solar ultra penetrating rays, would suffice to explain the observed facts

The conclusions put forward in this note certainly support the original ideas of Prof Nernst first mentioned in 1921[7] A few years ago, when the first results of observations on the daily period according to sidereal time were published, he wished that it were possible to increase the sensitivity of our apparatus until we could detect the ultra rays from a single stellar nebula or a single star I think the results put forward here indicate that a modest beginning has been made in this direction At least it has been possible now to detect the influence and the penetrating power of the ultra rays from the sun It may be added that the evidence here brought forward for a stellar origin of the cosmic ultra rays is completely independent of the existence of a daily period according to sidereal time, a subject which is still under discussion

VICTOR F HESS

Institute of Experimental Physics,
University of Graz, Austria,
Nov 4

[1] *Gerlands Beitr z Geophysik* **20**, p 52 1928
[2] *Gerlands Beitr z Geoph*, **26** 416 430, 1930
[3] *Zeitschr f Geophys* **3**, 179 1927
[4] *Sitz Ber Akad d Wiss Wien* II a **139** pp 281 318, 1930
[5] *Phys Zeitschr* **18**, p 585 1917
[6] *Zeitschr f Physik* **50**, pp 808 848 1928
[7] Das Weltgebäude im Lichte der neueren Forschung, Verlag Springer Berlin

An X-Ray Study of Mannitol, Dulcitol, and Mannose

A RECENT investigation, carried out at the Davy Faraday Laboratory of the Royal Institution, gave the following results for these three substances

Mannitol Space group, Q_4, $a = 8\ 65$ A $b = 16\ 90$ A, $c = 5\ 56$ A, density, 1 497 gm per c c, number of molecules per cell, 4

Dulcitol Space group, $C_{2h}{}^5$, $a = 8\ 61$ A, $b = 11\ 60$

A., $c = 9.05$ A., $\beta = 113° 45'$, density, 1.466 gm. per c.c., number of molecules per cell, 4.

Mannose. Space group, Q_4, $a = 7.62$ A., $b = 18.18$ A., $c = 5.67$ A., density, 1.501 gm. per c.c., number of molecules per cell, 4.

A study of the X-ray data suggests that in all three cases the long dimension of the molecule corresponds to the a axis; in the alcohols, the molecules appear to have the long chain configuration; in the sugar, that of the manno-pyranose ring, with the longest dimension in the direction of the a axis.

The reasons for assigning these structures to the various crystals will be discussed in a paper which will appear shortly.

THORA C. MARWICK.

Textile Physics Laboratory,
The University, Leeds, Nov. 29.

Structure of the Crystal Lattice of Cellulose.

FROM an examination of the available data for cellulose and the sugars, we have formed the conclusion that the six-atom sugar ring is associated in the crystalline state with certain linear dimensions which are approximately constant, and that at least one of these dimensions usually corresponds to one of the axial lengths of the unit cell. The existing crystallographic data are as follows:

	a	b	c	Density
Native cellulose	8.3	10.3	7.9, $\beta = 84°$ [1]	1.52
Hydrate cellulose	8.14	10.3	9.14, $\beta = 62°$ [2]	1.56
Cellobiose	5.0	13.2	11.1 $\beta = 90°$ [3]	1.556
Sucrose	11.0	8.7	7.65, $\beta = 103\frac{1}{2}°$ [4]	1.588
Mannose	7.62	18.18	5.67 [4]	1.501
Glucose	10.40	14.89	4.99*	1.544
Fructose	8.06	10.06	9.12*	1.598
Sorbose	6.12	18.24	6.43*	1.654

* Calculated from the density, crystal class and axial ratios.

The most striking feature of the above list is the small variation in density shown by these saccharoses. This in itself strongly suggests an approximate close-packing of some molecular unit, but when we arrange the data as in the following table, it becomes still more apparent how the dimensions of this unit—undoubtedly the sugar ring with its side-chain—impress themselves on the dimensions of the various unit cells.

	Axial Dimension	Cross-sectional Product	
Native cellulose	10.3	$8.3 \times 7.9 \sin 84 = 65.2$	66.6
Hydrate cellulose	10.3	$9.14 \times 8.14 \sin 62 = 65.7$	
Cellobiose	11.1	$5.0 \times 13.2 = 66.0$	
Mannose	5.67	$(\frac{1}{2}\times)18.18 \times 7.62 = 69.3$	
Sucrose	11.0	$8.7 \times 7.65 \cos 13\frac{1}{2} = 64.7$	
Sucrose	7.65	$(\frac{1}{2}\times)11.0 \times 8.7 \cos 13\frac{1}{2} = 46.5$	51.7
Glucose	$(2\times)7.45$	$10.40 \times 4.99 = 51.9$	
Mannose	7.62	$5.67 \times (\frac{1}{2}\times)18.18 = 51.5$	
Mannose	$(4\times)4.55$	$5.67 \times 7.62 = 43.2$	41.0
Fructose	$(2\times)4.56$	$(2\times)5.03 \times 8.06 = 40.6$	
Sorbose	$(4\times)4.56$	$6.12 \times 6.43 = 39.3$	

Putting $xy = 66.6$, $yz = 51.7$, and $xz = 41.0$, in order to determine the mean values of x, y, and z respectively, gives $x = 7.27$, $y = 5.64$, and $z = 2 \times 4.58$. We suggest that the interpretation of these results is that on the average, the sugar ring takes about $4\frac{1}{2}$ A. normal to the ring, about $5\frac{1}{2}$ A. across the ring in the direction of the cellulose chains, and about $7\frac{1}{2}$ A. across the ring in the direction of the side-chain, $-CH_2OH$.

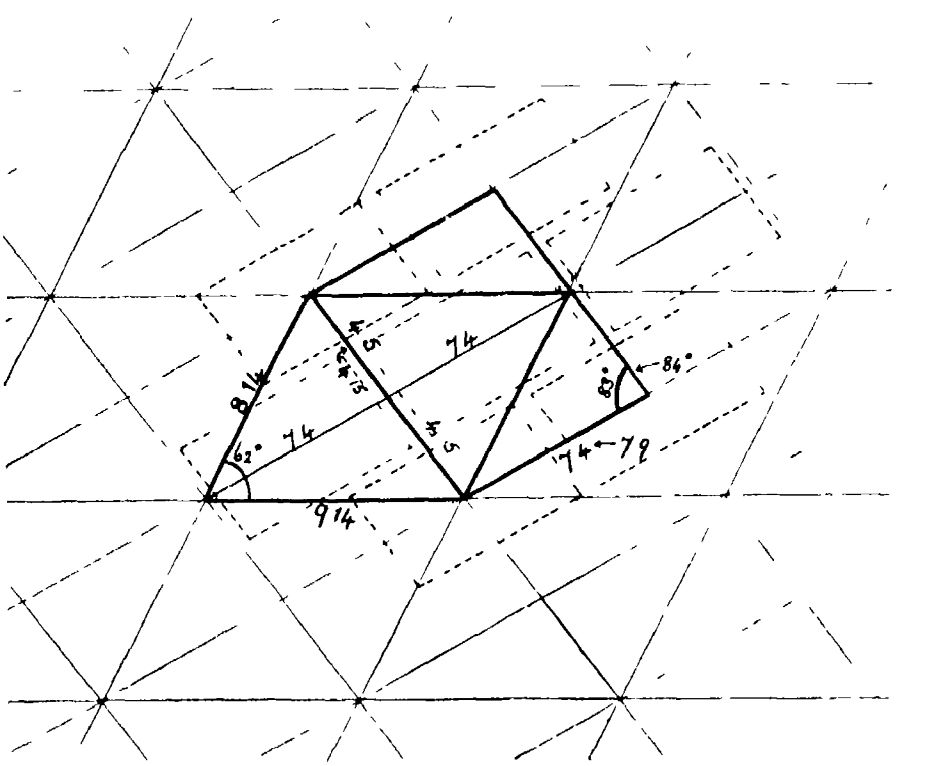

FIG. 1.

Applying now these values to the case of cellulose, we see that there is no *dimensional* reason why the plane of the hexagonal glucose residues should be taken parallel to the a axis (8.3 A.), as has been proposed by Meyer and Mark.[1] In fact, the balance of evidence, particularly the evidence to be derived from the dimensions of cellobiose and the stable form of cellulose (hydrate cellulose, mercerised cellulose), indicates that the plane of the rings should lie more nearly parallel to the c axis (7.9 A.).

The great advantage of this point of view lies in the way in which it links up the structures of native and mercerised cellulose, and in the simple picture which it offers of the mercerisation process. Fig. 1 shows diagrammatically how closely related are the two structures, and how small a change is required in order to pass from one to the other. The change in density is very small and it may be recalled that for some time it was believed that both native and mercerised cellulose gave rise to one and the same X-ray photograph. All this is quite in keeping with what we know of the changes in other dimorphous crystals.

Against these arguments must be placed the evi-

dence which has been adduced from intensity measurements But both the theory and practice of intensity measurements on natural fibres are in a very immature state, and it is risky to argue that any proposed structure of cellulose accounts for the paucity of X ray reflections, when a similar phenomenon is shown by other natural fibres, such as silk and hair, built up of totally different molecular units

W T ASTBURY
THORA C MARWICK
Textile Physics Laboratory,
The University, Leeds,
Nov 29

[1] Mark and Meyer *Z f physikal Chemie*, B, **2**, 115, 1929
[2] Andress, *Z f physikal Chemie*, **122**, 26, 1926 Burgeni and Kratky *Z f physikal Chemie*, B, **4**, 401, 1929
[3] Hengstenberg and Mark, *Z f Krist* **72** 301, 1929
[4] Astbury (sucrose) and Marwick (mannose) Unpublished results obtained in the Davy Faraday Laboratory of the Royal Institution

Ovoviviparity in Sea-Snakes

IN a communication on this subject in NATURE of Oct 11, 1930, p 568, Dr Smith discusses my note on *Laticauda colubrina* I am quite aware that Dr Smith's statement that all sea snakes are viviparous was something more than a mere reiteration, but I consider that both he and previous authors have generalised from insufficient data

When I wrote my previous note, I was fully alive to the fact that the deposition of eggs might conceivably be an abnormal occurrence, brought about by captivity I have since had the opportunity of investigating the matter more fully, and had prepared an account (to appear in the *Bulletin of the Raffles Museum*, No 5, which will be published shortly), before Dr Smith's letter appeared

Witnesses whom I have no reason to doubt have found the eggs and observed hatching This takes place on islands near Singapore in June, July, and August

Four females kept in captivity produced eggs, none of which contained an embryo, although some of the eggs were laid a considerable time after the snakes arrived

In view of the evidence which I have collected, on one hand and Dr Smith's remarks on a specimen of this species, containing embryos, on the other, only one conclusion appears possible the species must be capable of either type of reproduction Either a local race inhabiting the islands near Singapore is oviparous, or the individual is influenced by the possibility or otherwise of access to dry land * Such an explanation is by no means impossible, the Laticaudinæ are definitely in a transitional state between a terrestrial and an aquatic habitat, ovoviviparity *is a form of oviparity, and far removed* from true viviparity, a mere question of the point in development at which the egg already a separate entity, is deposited The form of the skull and of the ventral shields, the method of casting the skin, the presence of ticks, all point to a shore habitat in the locally obtained specimens of *Laticauda colubrina* The flat tail and, possibly, the colour are the only adaptations to a marine life

Dr Smith mentions a specimen which deposited eggs at the Zoological Society's Gardens, I believe this to be a specimen recently obtained by me off Singapore, and dispatched to the Zoo It appears to have borne out its local provenance by depositing eggs during August The fact that the eggs were laid singly proves nothing, two of my specimens laid batches of six

On the general question of reproduction in sea-snakes, then, it appears that we may say that the Hydrophiinæ, *in those species that have been observed*, bring forth their young alive, but there is no evidence to show whether they are truly viviparous or ovoviviparous, of the Laticaudinæ, examples of oviparity and ovoviviparity have been observed, and it is possible that these two degrees of the same condition may take place within the bounds of a single species

NORMAN SMEDLEY
Raffles Museum, Singapore, Nov 8

* Semper's discovery of a female guarding her young on land is strong evidence of oviparity It is almost inconceivable that a snake which has developed ovoviviparity a definite adaptation to an aquatic life, should take the trouble to come ashore to deposit its young

Periodic Process in a Chemical Reaction

THE accompanying photograph (Fig 1) shows a rather remarkable case of a periodic process in a chemical reaction The object shown is a potassium photoelectric cell made in this laboratory The cell was made by the usual method in which, after careful baking out of the glass, potassium is introduced by

FIG 1

distillation from a reservoir sealed on to the vacuum system The potassium was then formed into a uniform layer on the bulb and the window opened by gentle heating

On sealing off the cell from the pumps a minute crack occurred behind the projecting tube which encloses the cathode lead An exceptionally small leak was thereby caused and the potassium layer oxidised very slowly Instead of oxidising uniformly, sharply marked rings were attacked first Even when the potassium was completely oxidised the rings were still visible, as the oxide in them was white while the remainder was a very pale yellow and finally the material in the rings turned to liquid potash solution while the remainder was still solid

The rings are roughly circular with centres at the crack, and the approximate radii of successive rings measured along the surface of the bulb are as follows

Curve No	Radius	Curve No	Radius
1	1 2 cm	8	3 3 cm
2	1 85	9	3 7
3	2 2	10	4 1
4	2 5	11	4 5
5	2 7	12	5 0
6	2 9	13	5 6
7	3 1	14	6 6
		15	7 7

The diameter of the glass bulb was 6 6 cm

W T GIBSON
Les Laboratoires Standard,
46 Avenue de Breteuil,
Paris (VIIe), Oct 29

The Photosensitised Decomposition of Nitrogen Trichloride and the Induction Period of the Hydrogen-Chlorine Reaction

AN investigation was commenced by us about two years ago with the view of obtaining further evidence as to the mechanism of the induction period produced in the photochemical hydrogen-chlorine reaction by the addition of small measured quantities of ammonia and other substances[1]

In preliminary experiments with ammonia it was observed that a small continuous increase of pressure of strictly zero molecular order occurred during the induction period Ammonia reacts with excess of chlorine to produce nitrogen trichloride and ammonium chloride,[2] and the observed effect is explained as a photosensitised decomposition of the nitrogen chloride by the chlorine A closely similar reaction, terminating suddenly with a semi explosive pressure change, was observed in mixtures consisting of pure chlorine and small quantities of nitrogen trichloride only, the total pressure increases obtained corresponding to the net reaction

$$2NCl_3 = N_2 + 3Cl_2$$

Quantum efficiency measurements with homogeneous light of wave lengths 366 $\mu\mu$ and 436 $\mu\mu$ indicate that the photosensitised decomposition of the nitrogen trichloride in chlorine alone, proceeds by way of re action chains of short length, the quantum efficiency falling to a limiting value in the neighbourhood of 2 as the chlorine pressure is increased 'Inert' gases, such as helium, argon, nitrogen, and oxygen, have specific retarding effects when added to the mixture, and, as the pressures are increased, finally depress the quantum efficiency towards the above limiting value of about 2

Variation of the total illuminated or unilluminated surface is without measurable effect, and it would appear that the reaction chains are initiated and con trolled in the gas phase

A further study of the induction period has shown that hydrogen has a retarding influence on the decom position of the nitrogen trichloride numerically equal to that of helium

The inhibiting effect of nitrogen trichloride on the hydrogen-chlorine reaction may be explained in the light of modern views of the negative catalysis of chain reactions, and one is led to the conclusion that small quantities of hydrogen chloride, comparable in amount with the nitrogen trichloride destroyed, should be formed during the induction period This has been con firmed Details of these investigations, together with a quantitative interpretation of results, will be pub lished elsewhere at an early date

J G A GRIFFITHS
R G W NORRISH
Dept of Physical Chemistry,
Cambridge, Nov 22

[1] Chapman and McMahon *J Chem Soc* **95** 1717, 1909, **97**, 845 1910 Norrish *J Chem Soc* **127**, 2323 1925

[2] *Cf* Noyes and Haw *J Amer Chem Soc*, **42**, 2167, 1920

The Band Spectrum of Silver Hydride.

ON account of difficulties in getting a convenient source of light, earlier investigations on the band spectrum of silver hydride[1] (AgH) were mainly limited to a small wave length region at λ3180 λ3480 By means of a device, I have now been able to extend these investigations to a region including a very great number of bands

The source of light is an electric arc operating in hydrogen at reduced pressure The positive electrode is made of a silver aluminium alloy The aluminium (10 per cent) has a wonderful effect on the intensity of the silver hydride bands, and in addition the troubling N_2 spectrum disappears completely. The increase of the intensity is probably due to a decrease of tem perature in the arc—the alloy chosen corresponding to the minimum points on the melting diagram of Ag-Al—an effect quite analogous to that of the high potential small current arc used previously

In this way, the rotational structure of fourteen bands belonging to the $^1\Sigma \rightarrow {}^1\Sigma$ system in silver hydride have been analysed and arranged in a vibrational scheme It appears from this scheme, that the vibrational levels of the lower electronic state can be expressed by the formula

$$F''(v) - 1723\ 5v'' - 33\ 5v''^2 - 0\ 0094v''^3$$

The excited electronic state, however, exhibits certain irregularities of spacing in its rotational and vibra tional levels, which may originate from a perturbing electronic level An approximate calculation of the dissociation energy in both states gives us

$$D' \sim 6300 \text{ cm}^{-1} \qquad D'' \sim 19000 \text{ cm}^{-1}$$

Combining these values with that of the electronic frequency of the system ($\nu_0 - 29{,}900$ cm $^{-1}$) the energy difference between both products of dissociation will correspond to a term difference of about 19,000 cm $^{-1}$, and supposing that the hydrogen atom is left unexcited, this difference should fit into the term scheme of the silver atom It might be suggested that the normal level (^2S) and the still unknown $^2D'$ correspond to these products, but strong objections could be raised to this suggestion

The investigation is now being pursued with high dispersion showing a beautiful isotope effect in the bands This and the problems already mentioned will be discussed more fully in a future paper

ERNST BENGTSSON
Laboratory of Physics,
University of Stockholm,
Nov 19

[1] E Bengtsson and E Svensson *C R*, **180**, 274, 1925 E Hulthén and R V Zumstein *Phys Rev*, **28**, 13, 1926

Properties of Dielectrics in Electric Fields

I AGREE with Mr Addenbrooke, in his letter in NATURE of Nov 22, as to the desirability of avoiding the illogical nomenclature involved in applying the term 'dielectric constant' to a quantity which is apt to vary greatly according to the prevailing con ditions

I should like to point out, however, that this matter has not been overlooked by physicists and electrical engineers

We believe that V Karapetoff[1] first urged the use of the term 'permittivity' as originally proposed by O Heaviside[2] in place of specific inductive capacity This term is now common amongst British and American electrical engineers, and is given as preferred to specific inductive capacity, dielectric constant, etc, in the "British Standard Glossary of Terms used in Electrical Engineering", published by the British Engineering Standards Association in 1926 Further, the term 'inductivity' has also been proposed

It might be of interest to point out here that according to Faraday's conception, the specific in ductive capacity of a substance is a mere number, being the ratio of two measurements, one of which is made with the substance and the other with air or the ether (vacuum) as dielectric medium In arranging the system of units so that the specific inductive capacity of the ether is unity, the quantity still remains a numeric

According to Heaviside, however, a medium must

possess two physical properties if waves are to be propagated therein, and he therefore suggested it was desirable to postulate their real existence, and admit that they are measured by the 'permittivity' and 'permeability' of the substance in question, notwithstanding that the precise physical interpretation may remain unknown.

Something similar was done in regard to atomic weights, which were referred to the weight of the hydrogen atom taken as unity, before the real existence of atoms was established.

To this extent, therefore, it may be stated that the 'permittivity' and 'permeability' of a substance measure real physical properties, though, as in the case of the atomic theory with the discovery of atomic numbers, a more fundamental property may one day be found.

A. MORRIS THOMAS.

The British Electrical and Allied Industries Research Association,
36 and 38 Kingsway, London, W.C. 2,
Dec. 4.

[1] "The Electric Circuit", 1912.
[2] "Electromagnetic Theory", vol. 1, p. 21. 1893.

Conjunctival Halos.

THE halos familiar to those who resort to swimming baths at night present a subject of some interest. They are referred to in a pamphlet published by the Ministry of Health on "The Purification of the Water of Swimming Baths" (1929), p. 18, as follows: "Owing to the difference in composition between tears and bath water, any prolonged swim causes a slight mechanical or osmotic conjunctivitis, as may readily be observed, after a long swim, by looking at a distant light by night, when the light will be seen surrounded by a halo, due to slight conjunctivitis."

There are, in fact, two spectrum-coloured halos, each with its outer edge red, thus indicating diffraction as their cause. The inner halo shows considerable dispersion. It is noteworthy that, unlike the effect seen through lycopodium-covered glass, the space immediately surrounding the source of light is dark.

The radii of the halos are easily measured by means of a 'Jacob's rod', and are found to be:

Radius of red outer edge of 2nd order halo = 8° 25′
" " " 1st order halo = 4° 49′

The second order spectrum is comparatively faint and therefore the first order value is the more trustworthy.

Inserting this in the equation $(a+b)\sin\theta = (2n+1)\frac{\lambda}{2}$, and taking the wave-length of the red light as $700\mu\mu$, we get 0.0125 mm. as the value of the 'grating interval' $(a+b)$. The second order spectrum gives the value 0.0120 mm.

It seems, therefore, that the surface of the cornea is covered with structural elements of this order of magnitude. Shelford Bidwell arrived at a similar conclusion from other evidence. The experiment described in his "Curiosities of Light and Sight" (1899), pp. 124-129, indicates the existence of elements $\frac{1}{2000}$ inch (0.0127 mm.) in length or breadth.

The refractive index of the cornea is 1.350 (Krause, in Helmholtz), and of water 1.333. This difference is evidently enough to bring the structure into sufficient relief to produce the diffraction.

Tyndall (*Phil. Mag.*, [4], vol. 11, p. 332, 1856) has described a similar effect in which the centre of the ring system is bright.

SIDNEY MELMORE.

The Yorkshire Museum,
York.

An Ostrich Shamming 'Wounded'.

THE device of pretending to be wounded in order to lure marauders from the nest is one that has been recorded in the case of a considerable number of species of ground-nesting birds, mostly belonging to the more specialised families. So far as I can recollect, it has never been observed in the case of the ostrich.

Dr. T. A. Nash, a former pupil of mine now in the service of the Government of Tanganyika, writes to me as follows:—'On Oct. 24 last I noticed a male ostrich coming straight towards me, not farther off than 50 yards. The bird trailed its wings as if they were broken, and then seeing me, started off slowly at right angles to its original direction. One wing would flap spasmodically and then the ostrich would sit down, looking backwards to see how near I was. As I approached, the bird would stagger to its feet, lumber on a few yards, and then sink down. Once it appeared to be too weak to stand up and toppled over on to its side, where it lay panting. Feeling certain that the ostrich had been mauled by a lion, I called for my rifle in order to shoot it, when one of the boys called, 'The bird is well and only acting; it must have a nest near.' Leaving one boy to watch the bird, the rest of us retraced our steps, and we found the nest about 40 yards away from where I had first seen the bird.

'The 'nest' simply consisted of a clearing in the grass, with eight young birds sitting on the powdered black earth amidst broken egg-shells. Other young had scuttled off into the long grass. In addition, there was one egg in the nest. Without touching anything, we concealed ourselves at some distance off. Almost immediately we saw the male trotting back in perfect health, accompanied by the female. The female must have been at some distance off, feeding, the male being left to look after the nest—and very well he did it.'

It is interesting to find such intelligent behaviour in so primitive a bird as the ostrich.

E. W. MACBRIDE.

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Letter from Charles Darwin to Lord Farrer.

I SEND herewith a copy of a letter to the late Lord Farrer from my father, Charles Darwin. So far as I can ascertain, it has never been published. It was evidently dictated, probably in the afternoon when tired by his morning's work. His remarks on observation and reasoning seem to me to be of especial interest. A letter on the same subject, definitely admitting his error, is given in "More Letters", vol. 2, p. 373.

"May 19, 1868.

"Many thanks for your notes. I do not doubt that you are right and I wrong. How I came to make such a blunder I do not know, for I examined the flowers repeatedly. I suppose I reasoned from the shape of the caudicle, and it is a fatal fault to reason whilst observing, though so necessary beforehand and so useful afterwards. I will try to find a specimen to convict myself. I wish you or someone could find out what insects visit the fly ophrys and for what purpose. I am delighted to hear that you are interested about the structure of orchids. I was formerly quite fascinated with these plants, especially with O. Pyramidalis and the common listera."

LEONARD DARWIN.

Cripps's Corner, Forest Row,
Sussex, Dec. 4.

Stellar Structure and the Origin of Stellar Energy *

By Prof E A MILNE, F R S

PERHAPS the most striking general characteristic of the stars is that they can be divided into two groups of widely differing densities In the first group, which comprises the majority of the known stars, the densities are of 'terrestrial' order of magnitude, that is to say, their mean densities are of the order of the known densities of gases, liquids, and solids They range from one-millionth of that of water to ten or, in rare cases, perhaps fifty times that of water In the second group the densities are of the order of 100,000 times that of water Of the second group, the 'white dwarfs', only a few examples are known, but they are all near by stars, and it is generally agreed that they must be of very frequent occurrence in Nature, though difficult of discovery owing to their faintness Whether stars exist of intermediate density remains for future observation The possibility of the existence of matter in this dense state offers no difficulty As pointed out by Eddington, we simply have to suppose the atoms ionised down to free electrons and bare nuclei At these high densities the matter will form a degenerate gas, as first pointed out by R H Fowler But this leaves entirely unsolved the question of why, under stellar conditions, matter sometimes takes up the 'normal' density and sometimes the high density Owing to the probable great frequency of occurrence of dense stars, it might reasonably be asked of any theory of stellar constitution that it should account for dense stars in an unforced way

There are two main theories of stellar structure at the present moment That of Sir James Jeans accounts for the existence of giants, dwarfs, and white dwarfs, but only at the cost of *ad hoc* hypotheses quite outside physics It assumes stars to contain atoms of atomic weight higher than that observed on earth, and it assumes them to be relentlessly disappearing in the form of radiation, it appeals to discontinuous changes of state consequent on successive ionisations, for which there is little warrant I think it is true to say that the majority of astronomers do not accept this theory

The theory of Sir Arthur Eddington does not claim to account for the observed division of stars into dense stars and stars of ordinary density, nor does it establish the division of ordinary stars into giants and dwarfs On the other hand, it claims to establish what is known as the mass luminosity law from considerations of equilibrium only, that is, without introducing anything connected with the physics of the generation of energy It claims to show that the observed fact that the brighter stars are the more massive can be deduced from the conditions expressing that the star is in a steady state, mechanically and thermally It does this by making the hypothesis that the stars (giants and ordinary dwarfs) consist of perfect gas Closer consideration of the actual formulæ used by the theory shows that it scarcely bears out the claims made for it by its originator The 'formula for the luminosity' of a star makes the luminosity very nearly proportional to its effective temperature, and so the so-called proof of the mass luminosity law involves a semi-empirical element, namely, an appeal to the observed effective temperatures of the stars, for the observed values of which the theory *fails to account* Another difficulty encountered by the theory is that it makes the interiors of the more luminous (giant) stars cooler than those of the fainter stars, and it makes the interiors of both too cool for the temperature to have any appreciable influence on the rate of generation of energy, by stimulating, for example, the production of radioactive elements or the conversion of matter to radiation

The claim to establish the mass-luminosity law from mere equilibrium considerations cannot, however, be sustained for a moment We may regard a star in a steady state as a system provided with an internal heating apparatus (the source of energy) It adjusts itself—state of aggregation, density distribution, temperature distribution—until the surface emission equals the internal generation of energy L But provided the luminosity L is not too large (in order that the mass shall not burst under radiation pressure), it is clear that a given mass M can adjust itself to suit any arbitrary value of L If, starting with one steady state, we then alter L (upwards or downwards) by altering the rate of supply of energy, the star will simply heat up or cool down until the surface emission is equal to the new volume of L—precisely like an electric fire L and M are thus independent variables so far as steady-state considerations are concerned The fact that L and M show a degree of correlation in Nature must be connected with facts of an altogether different order, namely, with the physics of energy generation It is essential to recognise the difference between the formal independence of L and M as regards steady-state considerations and the observed correlation of L with M in Nature The observed mass luminosity law must depend on the circumstance that in some way the more massive star contrives to provide itself with a stronger set of sources The claim to establish the mass luminosity law from equilibrium considerations only appears to me a philosophical blunder Further, it is unphilosophical to *assume* the interior of a gas to be a perfect gas, either knowledge of the interior is for ever unattainable or we should be able to infer it from the observable outer layers

When we dispense with the perfect gas hypothesis and at the same time recognise the independence of L and M as regards steady-state considerations, it is found that a rational analysis of stellar structure automatically accounts for the existence of dense stars without special hypothesis Further, it shows, as common sense would lead us to expect, that the more luminous stars must have

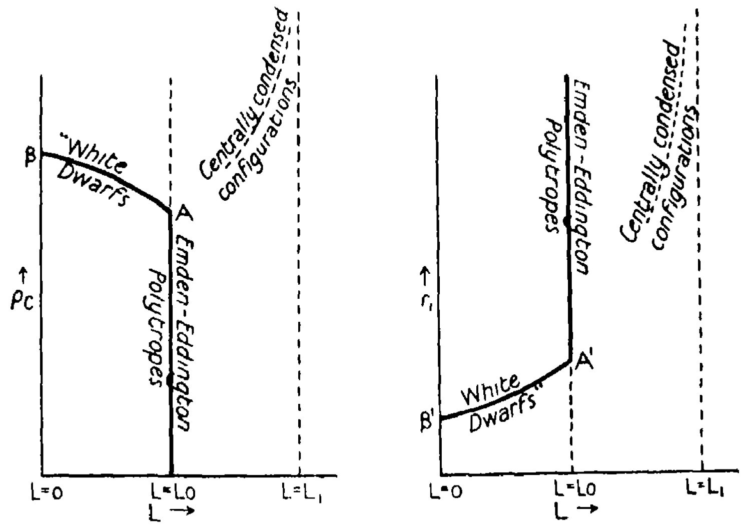
* Substance of lectures delivered at the Royal Institution on Dec 2 and Dec 9, 1930

the hotter interiors Here the temperatures are found to range up to 10^{10} degrees or higher, depending on luminosity—a temperature sufficient to stimulate the conversion of matter into radiation In addition, it shows that the central regions of stars must be very dense, ranging up to 10^7 grams cm $^{-3}$ or higher Thus the difficulties met by earlier theories fall away as soon as the ground is cleared philosophically

The foregoing ideas suggest the following as the fundamental problems of stellar structure (1) What are the configurations of equilibrium of a prescribed mass M as its luminosity L ranges from 0 upwards, M remaining constant ? (2) What is the effective temperature T_e associated with a given pair (M, L) in a steady state ? (3) What is the value of L which will actually occur for the physical conditions disclosed by the answer to problem (1) ?

We observe that the outer parts of a star are gaseous Consequently we can solve the problem of the state of any actual star by integrating the equations of equilibrium *from the boundary inwards*, we are entitled to assume the gas laws to go on holding until we find that the conditions are incompatible with them We then change to a new equation of state, and carry on as before We change our equation of state as often as may be necessary until we arrive at the centre

The answer to the first of the problems formulated above has been worked out, for certain types of source distribution and opacity, by the method of inward integration The results are sufficiently alike to be taken as affording insight into the nature of stellar structure in general, and are as follows For a given mass M, of prescribed opacity, there exist two critical luminosities L_1 and L_0 $(L_1 > L_0)$ such that for $L > L_1$ no configurations of equilibrium exist, for $L_1 > L > L_0$ the density and temperature increase very rapidly as the centre is approached $\left(T \propto r^{-1}\left(\log \frac{\text{const}}{r}\right)^{-\frac{1}{4}}\right)$, so that in the centre there is a region of very high temperatures and densities where the gas laws are violated, for $L = L_0$ a diffuse perfect gas configuration is possible, for $L_0 > L > 0$ the only perfect gas configuration is a hollow shell provided with an internal, rigid supporting surface of spherical shape Since in Nature no internal supporting surface is provided, to find the actual configuration when $L_0 > L > 0$ we construct the artificially supported hollow configuration and then remove the supporting surface The mass must collapse, and collapse will proceed until a steady-state is attained in which, except for a gaseous outer fringe, the gas laws are violated Such configurations may be termed 'collapsed' Configurations for which $L_1 > L > L_0$ may be termed 'centrally-condensed' The physical origin of the different types of configuration is simply the varying effect of light pressure For $L = L_0$ the light-pressure due to L is just sufficient to distend the star against its self gravity and maintain it in the form of a perfect gas For $L_1 > L > L_0$ light-pressure is so high that for equilibrium to be maintained gravity at any given distance from the centre must be assisted by concentrating as much matter as possible inside the sphere in question, when this process is carried out for all spheres, we get a central condensation For $L_0 > L > 0$, light pressure due to L is so low that the mass cannot support itself against its own weight in the form of perfect gas, and collapse sets in until the gas laws are disobeyed The diffuse configurations $L = L_0$ are unstable with respect to small changes of L



FIGS 1 and 2 —The linear series of steady state configurations of a mass M, of prescribed opacity, as its luminosity L varies (The white dwarfs are the collapsed configurations of the general theory The Emden Eddington polytropes are the gaseous diffuse configurations of the general theory they are unstable in general with regard to deviations of L on either side of the value L_0 The centrally condensed series has not been fully worked out—it awaits the construction of certain tables—but it may be provisionally identified with stars in the state of giants and ordinary dwarfs The diagram is to be understood as classificatory not evolutionary) (ρ_c = central density r_1 = external radius)

For collapsed or centrally condensed configurations the centre will be occupied by a gas in a degenerate state When the mean densities or effective temperatures of collapsed configurations are calculated, using the Fermi Dirac statistics for the degenerate gas, they are found to agree with the observed order of magnitude for white dwarfs Thus, collapsed configurations may be identified with white dwarfs A white dwarf is thus a dense star simply because its luminosity is too low, and its light pressure accordingly too low, for it to support its own mass against its own gravity From another point of view the calculation affords an observational verification of the numerical value of the 'degenerate gas constant' the coefficient K in the degenerate gas law $p = K\rho^{5/3}$, and so a check on the Fermi Dirac statistics

If collapsed configurations may be identified with white dwarfs, centrally condensed configurations

may be provisionally identified with ordinary giants and dwarfs, though the full determination of the properties of centrally-condensed configurations awaits the construction of certain tables Centrally-condensed configurations appear to have the properties that as L decreases from L_1 to L_0 the effective temperature rises to a maximum and then decreases again This would correspond to the observed division into giants and dwarfs I give this deduction with some caution, as it is not yet demonstrated rigorously in the absence of the tables above mentioned

A point not yet settled is the question of the continuity of the series of centrally condensed configurations with the collapsed configurations (Figs 1 and 2) There are indications that as L passes through L_0 *from above to below, the external radius* of the configuration may decrease discontinuously, the gaseous envelope collapsing on to the dense core If this is confirmed, it would follow that a star, when its steady state luminosity L falls through a certain critical value (depending on its mass), exhibits the phenomena of a nova or temporary star For it would have to disengage a large amount of gravitational potential energy in a short time, so that the actual emission would undergo a temporary increase, falling again to a value just below its previous value It would be highly interesting to have observational data as to the densities of a nova before and after the outburst The early type spectrum of the later stage of a nova may indeed be taken to indicate a high effective temperature, and so a small radius and high density, in accordance with our prediction

The important point about all the foregoing analysis is that it involves at no stage any special properties of matter or special assumptions The observed features of the stars are thus found to depend only on the most general properties of matter in association with light pressure

A question logically distinct from these is the origin of stellar energy Here we require to know something of the physics of energy generation The following suggestions are frankly of a speculative character Let us assume, in accordance with a hypothesis first made by Jeans (not his later hypothesis of super radioactive atoms), that protons and electrons can unite to form radiation Then thermodynamic considerations show that the process must be *reversible*—*photons can generate* matter We know that matter at ordinary temperatures is stable Hence we may postulate the existence of a critical temperature above which the process can go on in either direction Suppose this critical temperature has been passed at 10^{11} degrees Calculation then shows that at 10^{11} degrees almost the whole of the *mass* in an *enclosure* would be in the form of radiation, and further, that lowering of the temperature of the enclosure would result in more of the surviving matter present disappearing in the form of radiation The process is in fact the thermodynamic opposite of evaporation steam condenses to water with emission of energy, and the process is accordingly encouraged by cooling, matter 'evaporates' (to radiation) with emission of energy, and the process is encouraged by cooling Now, the centre of a star is a sort of thermodynamic enclosure with a slight leak It follows that if (as the steady state theory indicates) the central region of a fairly luminous star is at a temperature of 10^{11} degrees and a high density, then this central region is effectively a reservoir of very dense radiant energy, with a mere sprinkling of ordinary matter present Natural cooling of this reservoir provides the star's emission to space, and the reservoir is itself maintained by the conversion of matter into radiation inside it and on its confines

Calculations based on this idea are consistent with the usually accepted evolutionary time scale, and predict a rate of 'generation' of energy ϵ per gram of the right order, namely, $\epsilon = -\frac{4c^2}{T}\frac{dT}{dt}$ throughout the mass of the core, where $-dT/dt$ is the rate of cooling The rate of loss of mass is given by the usual formula $\frac{dM}{dt} = -\frac{L}{c^2}$ By combination of these formulæ it is found possible in principle to establish a relation linking M with T_c (the central temperature), *this is the additional relation which, by* expression of T_c in terms of L and M by means of the steady state theory, must lead in due course to a mass luminosity correlation Whether it agrees with the observed mass luminosity law remains for future investigation, but it is a final satisfaction that, after first considering L and M as independent variables, we are able to use the equilibrium configurations thus disclosed to arrive in outline at a solution of the problem of the actual correlation of mass and luminosity in Nature It is to be noted that the star's generation of energy is naturally non explosive, for it is simply a consequence of the natural tendency of the star to cool The star behaves, in fact, simply like a freely cooling body containing a central region of very high specific heat—namely, a pool of intense radiant energy, which is gradually drained away though partially reinforced by the conversion of matter From this point of view, it is not that a star descends an evolutionary path because its rate of generation of energy slackens, it is rather that the act of evolving and the act of radiating energy are identical

These suggestions as to the origin of stellar energy and the mode of stellar evolution are not to be pressed They are to be sharply distinguished from the steady state theory, which by the rational process of proceeding from the known stellar exterior step by step into the unknown interior indicates an inevitable series of configurations which correspond to the observed bifurcation of celestial objects into 'ordinary' stars and 'dense' stars

NOTE —The fundamental result of the rational method of analysis of stellar structure described in the foregoing article is the division of configurations into two types, the 'collapsed' and the 'centrally condensed' The existence of these two types can be demonstrated without complicated mathematics by the following argument Let r_1

(*Continued on p* 27)

Supplement to NATURE

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Biology in Education and Human Life *

By Prof A V Hill, F R S

DURING the last quarter of a century it has gradually been realised that biological science, no less than physical science, has an important rôle to play in the affairs of human life Man is a creature partly of his inheritance (which we are just beginning to understand), partly of his environment and education (which have long been matters of study and discussion) His nature, as a sensitive, responsive, and creative being, is determined partly by the material—in a wide biological sense—of which he is constructed, partly by the treatment to which—in development and education—that material has been subjected

Human Nature and Environment

I would not deny—far from it—the extreme importance of the environment of the traditions, of the stores of wealth and knowledge, of the accumulations of wisdom, wit, and loving kindness which surround us Do not imagine that experimental science leads necessarily to materialism in those who follow it Like Martha, indeed, we are often cumbered about much serving in our laboratories we have to be careful and troubled about many things—including the working of our apparatus which leaves us often, alas, with too little time for reading or reflection Those of you however, who, like Mary, have chosen the good part, do not be too sure that we poor experimental scientists are entirely lacking in appreciation of the more spiritual affairs It is only when provoked by theological dogma, or by prejudice blinding people's eyes to the most evident facts, that we lose our heads and tempers and become breakers of idols Naturally, I think, we are sane and reasonable people, people who if treated with a little kindness and understanding may often be made quite decent members of society Admitting however, the value of the accumulated wealth and wisdom in our environment, of the culture stored by centuries of thought and labour, the hard facts of experience and experiment tell us certain things, which cannot be denied, as to the biological background of our human nature These things, of which so many educated people are quite, or almost, unaware, are what I wish to discuss here

Each of us arose from the union of two cells, one of which alone decided the sex to which we belong Our inheritance of bodily characteristics and of mental tendencies was determined by certain elements in those cells, elements the separate existence of which is as certain as that of atoms and electrons Our bodies and our nervous systems developed in a certain way, affected—but not settled—by our environment, through the continual division of those cells The finished product—ourselves—depends for its proper functioning upon a variety of measurable factors, internal and external to the body Our children inherit the same tendencies and possibilities visible or latent, as we do, masked or exaggerated by the tendencies and possibilities of their other parents Health and happiness, power to contribute to the common stock, are linked as functions of the many variables of inheritance and surroundings The peculiarities of brain and nervous system, of internal secretions and digestion, are mingled with education and environment, with poetry and religion, in producing mind and character Great, therefore, as are our birthrights of environment, vast as are the unconscious effects of tradition and upbringing, we delude ourselves if we do not recognise that the nature of man the individual, and of mankind the organised society, depends in large measure on biological factors

The General Ignorance of Biology

It is easy to be too ignorant of these elementary facts it is possible for grown up men and women, otherwise educated people, to be wholly unaware of all that pertains to the science of living things Even among scientific men themselves, many are quite innocent of any acquaintance with that major half of natural knowledge which comes under the category of biology What would they say of a biological colleague who knew nothing of elementary

* Being the Henry Sidgwick Memorial Lecture delivered at Newnham College Cambridge on Nov 22

algebra, who could not use simple physical apparatus, who had never learnt to employ a balance, who could not tell the difference between momentum and energy? So great indeed is their innocence that many of them suppose the problems of biology to be quite simple, only rather messy and inexact! How many historians, scholars, lawyers, even philosophers, have any biological knowledge? Yet what would they think of a biologist who was completely ignorant of history, literature, or philosophy, who could not read a single foreign language? It would seem, however, that to be unversed in matters so important as those with which biology deals, and withal of such supreme interest, is no less to be deplored than to be quite unlearned in humane letters.

It is possible in the University of Cambridge to obtain an honours degree in science by taking the Natural Sciences Tripos and studying only physics, chemistry, and mathematics. It would be equally possible to take three biological subjects, but these would necessitate at least a certain knowledge of chemistry and physics. No man or woman, I feel, should be able to go out from this place with the hall mark of a scientist who has not taken, here or at school, some course in general biology. Many unfortunates, gifted with no power of solving equations or of conjuring with triangles, struggle for years in attempting to pass the mathematical examination for matriculation in various universities: and yet there is no requirement at all of knowledge far more fundamental to human life than mathematics. Latin our children must take in the 'Little Go': Latin is essential to the proper understanding of literature: biology only to the proper understanding of man! Mathematics and Latin are an excellent discipline for the mind: granted for those who have that kind of mind. But would you teach them these to the exclusion of all more natural knowledge? Would our colleagues in those subjects, often knowing nothing of biology, dare to assert that there is no mental discipline to be found in the study of life phenomena? Few discoveries are of such general significance, such universal application, not many facts have had such an effect on human thought in all its aspects, as that of evolution. Are the implications of evolution of less significance than those of the binomial theorem or of Latin grammar?

Economics deals with human life, with man in his social aspects; it cannot fail to be concerned with problems of population, food supply and transport, public health, heredity, eugenics, psychology, and medicine: all matters of great significance involving, if they are to be properly understood, the biological factor. How many economists have any acquaintance with biology? Admitting the value and importance of history as a factor in political economy, admitting the mental discipline of the classics and (for the sake of argument) the greater grace and dignity of the writings of those who have been brought up on Greek and Latin; admitting that mathematics enables the student to think in terms of flux and change, and is bound to aid in a study involving probability and the laws of large numbers of differing individuals: admitting all these things, is there no place for biology in a scheme of teaching and research in economics? I do not imply that economists should be experimental biologists. We teach physics and chemistry to our medical students, not because we expect most of them to use these sciences in their practice—they certainly will not—but as a necessary discipline and preparation for their minds. To exclude physics and chemistry from medicine would seem just as reasonable as to omit biology from political economy.

Biology in Relation to other Science

One difficulty in the teaching of biological science arises from the fact that this requires a knowledge of other things: of chemistry and physics, of a certain minimum of mathematics. It is possible for a mathematician, a physicist, or a chemist to be unaware of most that lies outside his proper study. Such narrowness is rarely found in a biologist: his work requires at least a nodding acquaintance with the other sciences. Except to the pure naturalist, and often indeed to him, the phenomena of life are bound to raise questions of chemistry and physics, or of meteorology and geography, at every turn. The coefficient of thermal expansion of water, for example, and its variation with temperature, determine the relative richness of cold and tropical regions in living fauna. Currents and climate, temperature and radiation, the constitution of the land, the composition of the air, these determine the incidence and possibilities of life. The concentrations of phosphate and nitrate in sea water are limiting factors in the amount of its living material; solar radiation acting on the plankton determines the great growth of spring and early summer. The presence of carbon dioxide in the air, of iodine, calcium, and oxygen in the streams: such factors, and an infinite variety of others, provide a necessary basis for any discussion of the natural habits and development of animals and plants.

Often enough the physical and chemical questions provided by life are very complex and difficult, requiring special training and experience for their solution. Herein, indeed lies the difficulty, not only in teaching biology, but also in tempting the ablest minds to take it up as a profession.

This difficulty can be solved only by a compromise. In its elementary stages the study of biology provides little of the discipline which we associate with mathematics, or with Latin and Greek. There is no *pons asinorum*: there are no things peculiarly difficult to understand; there are no problems to solve, no examples to set, no proses to translate, no poems to juggle into hexameters. The mind, like the body, can only be trained to its best performance by setting it to do what is hard, in facing and overcoming difficulties, in making efforts not merely of repetition but also of achievement. Elementary biology provides little of the mental gymnastics which we associate with these older studies. Moreover, in all but its simpler stages, biology requires a knowledge of other sciences: without these large fields of it are meaningless. The tendency, therefore, and in principle a good one, is to teach those other sciences first. Unless, however, we are prepared to tolerate a degree of specialisation in our schools which is undesirable both for education and for science itself, there is little time or opportunity left for still another scientific subject. Biology in consequence is left to take a second place—or no place at all—at school. The best minds of the coming generation are steeped in mathematics and physical science—if in any science—and it is difficult later to draw them off into biology.

Recruits to Biology

In the past the recruits to physiology and other biological subjects came largely from those who had studied classics and mathematics in their earlier days and then decided to devote themselves to natural science. The Science Tripos at Cambridge—as it was—had a great advantage in this respect, by leading many of the ablest students to study one at least of the biological subjects. The possibility of taking mathematics, as well as physics and chemistry, has largely closed that channel. I am sufficient of a reactionary to feel some of the advantages of the older traditional type of education. The practical difficulty has arisen owing to the much more widespread teaching of science at school. In previous days we came to a university with our minds open, and if we decided to study science we chose our subjects without prejudice. By the time, nowadays, that a student has spent at school some years already at one subject, he is unlikely to be so reckless as to burn his boats and transfer his allegiance elsewhere. Moreover, there is such a demand by their teachers for men and women of the highest ability, that every possible inducement is offered them, if they be able enough, to remain where they are.

I know that my mathematical and physical friends would be deeply grieved — and quite rightly, from their own point of view—were we biologists able to tap the source of their ablest students. Our problems, however, are at least as important, at least as interesting, and far more difficult than theirs, and I have no doubt at all that many of the ablest workers in our universities who now devote themselves to mathematics, physics, and chemistry would have made, had they been caught early, equally distinguished biologists. I am sure, indeed, that many of our classical or legal friends, had they been given the chance, would have done at least the same: they are not so incompetent either! As a practical step, biology must demand that, with all its intellectual interest and its importance in human affairs, it should be brought sufficiently to the attention of boys and girls to enable them to decide with their eyes open whether that, or something else, is what they wish to study. The quality of our recruits would rise, could time be found in the last few years of school to introduce, in a general way, the ideas and possibilities of biological science. Those should be regarded as lacking education who are altogether ignorant of the nature of living things.

Biology an Essential Factor in Education

The discipline of the mind, important as it is, is not the only object in education, any more than is the production of athletic champions the chief purpose of physical training. Many of the subjects taught at school—history, geography, modern languages, poetry, divinity, music—are to be regarded rather from the point of view of their cultural value than as simple mental gymnastics. Experience has shown that biology also can be included in this larger category, even for children of a relatively tender age. An admirable pamphlet, "Biology in the Elementary Schools and its Contribution to Sex Education", published by the American Social Hygiene Association, describes a series of experiments in the teaching of biology, even to quite young children, by a group

of sympathetic and intelligent people "To children in general, regardless of their upbringing, the world of living nature is vastly interesting" "Children have shown in the course of their studies in biology ample evidence of their ability to classify facts, recognise relations between ideas, make generalisations, formulate results" "They have found new problems in old haunts, have examined them resourcefully, critically, objectively" It is true that such teaching requires more skill and understanding, more forethought and preparation than much of the established routine of the schools Biology poorly taught is as bad as history poorly taught To introduce biology wholesale, and without the provision of intelligent and sympathetic teachers, might be dangerous and would certainly lower its value as an ingredient in a humane and liberal education Let us retain without question the subjects which discipline the mind by their formal precision, their logical difficulties but among those which are taught in order to breed a wider understanding of the world, I would urge that, in the ideal school, biology in its general aspects should have an assured and honourable place That place, however, must be acquired gradually

In a variety of ways such a minimum of biological knowledge as I would have every child possess can minister to his or her needs and thoughts and difficulties The problems of sex are much simpler if seen from the natural and objective point of view Reproduction is an honest and straightforward matter from the biological aspect Inborn differences in mental and physical qualities, and the manner of their origin, are essential factors in the structure of society our views of human relationships are bound to be affected by the existence of such differences—and to breed rational views on human relationships is one chief purpose of education The basis of the family or the tribe, the relative effects of inheritance and environment, the aristocratic or the democratic principles in government, all these are matters which lively young minds will ponder and debate, and which ultimately depend upon the intrinsic properties of man, the biological unit Problems of mental and bodily health, of nutrition, of physical training, of disease, belonging naturally in one sense to medicine, are most readily approached by children, as by adults, through the channel of biology

It is possible, of course, to trade on ignorance, for selfish and even for unselfish ends Those who believe in war may object to enlightened education on matters pertaining to reproduction as likely to diminish the supply of 'cannon fodder' Those who desire to maintain the rights of inherited power, or rank, or wealth, may prefer to uphold the biological fallacy underlying an aristocratic constitution of society Those who look to socialism as a cure for human ills may try to disguise the fact that all individuals are not, and cannot conceivably be made, alike in quality or character To all, however, who desire to know and to spread the truth in such matters, trusting in the good sense of mankind, there can be no question that if the claims of biology are verified, it is right to demand for it a proper place in education

Inheritance and Eugenics

Can the claims of biology be verified? I will give a few examples Let us take first the subject of inheritance, and assume (for the sake of argument and simplicity) the gene theory of its mechanism In recent years, owing to careful experimental studies, the manner in which natural characteristics are inherited or handed on has become apparent, if not in detail, at least in general outline There are many common fallacies about inheritance, derived from imperfect experimental knowledge or by false deduction from experience Much of so called eugenics is based upon such fallacies It is often imagined, for example, that by preventing the breeding of feeble minded individuals the race might in a few generations be completely relieved of the burden of feeble mindedness Assuming (to quote Jennings) that the feeble minded make up about one third of one per cent of the population, it is possible to compute that about ten per cent of the population bear *one* of the defective genes, a pair of which lead to the defect in question In a population of 50 millions there is a group of 45 millions having none of the defective genes at all, another group of 5 millions, quite normal minded but with one defective gene, people whom we may describe as carriers of feeble-mindedness, the defect being latent but ready to appear in the offspring if combined with a similar one from the other parent, and a minor group of 160,000 actual feeble minded, carrying two defective genes If both the second and the third groups together could be prevented from breeding, feeble mindedness could be eliminated in a single generation This, however, in our present state of knowledge, is quite an impossible achievement, there is no way of recognising a defective recessive gene except in its occasional effect on the offspring If we could prevent—and to this there are merely the usual sentimental objections—

the breeding only of the third group, the actual feeble-minded, we should get rid at once of about 11 per cent of these defective people in the next generation

The procedure, however, of eliminating this 11 per cent would have affected very little the reservoir of carriers, the five million just mentioned Repeated in the next generation it would have comparatively little additional effect, and would need to be continued indefinitely to maintain even the ground gained I am not saying that this should not be done—it *should* be done, but we must not expect too much from it It has been computed that if a character governed by these rules affected one per thousand of the population, and if we attempted to eliminate it by preventing the propagation of those who possess its two defective genes, it would require 68 generations (or 2000-3000 years) to reduce its incidence to 1 in 10,000 Two morals may be drawn (1) that eugenic hindrance to breeding, with the knowledge we now possess, might produce a definite but not a startling effect in bettering the race, and (2) that research in such matters should be pressed on, for if we could find the means of recognising latent defective genes in those who carry them, we should have forged a tool which, in a single generation if men would submit to its use, would relieve mankind for ever, or at least until they arose spontaneously again, of some of the scourges of the race

Mankind, in all probability, has many millions of years yet to run before forces quite outside our control finally render the earth unfit for habitation Anything which we can do, by rearing a fitter race of men, to make the future happier and richer would seem to be well done Some qualities are obviously more desirable than others There exist human beings who are vigorous, wise, virtuous others that are not, the differences depend in part upon inheritance Could we eliminate the tendencies not only to undesirable mental qualities but also to harmful physical ones—susceptibility to disease such as cancer and tuberculosis, deformities, various forms of weakness and unfitness—how happy and how beautiful a race might yet reign upon the earth Look, as Jennings says in his book, "The Biological Basis of Human Nature", on what has been done for the breeds of cattle and poultry and for cultivated plants Shall we use, it is often asked, our knowledge of genetics for the improvement of domestic animals and fruits, and neglect the infinitely more important improvement of the human stock? This is the question which eugenists ask The answer—to some a very unexpected one—can readily be given, loosely quoting Jennings's words

"There is no obstacle in the known principles of genetic science to the attainment of such a result, provided we can decide on the qualities we wish to preserve or promote in our human stock, and provided that the necessary methods are applied with the necessary thoroughness for the necessary length of time The difficulties are not in the theory but in the practice A practical breeder must be placed in complete control with instructions to fear not God neither regard man in the execution of his project He will mate a few individuals possessing characteristics as near the desired ones as he can find, and he will stop the propagation of the rest Then he will proceed to bring to light the defective genes by reversing the rule of family eugenics, that is the canons against inbreeding The selected progeny of his first cross will be inbred, as cattle are inbred This will bring together, on the one hand, defective genes, on the other, desirable genes, the results will appear in the personal characteristics of the individuals produced A great stock of defective and deformed individuals will appear along with a number that are not defective or are less defective Those showing undesirable traits will again be eliminated, the rest again inbred By a continuation of this process, with at times judicious crossing of superior individuals followed by further inbreeding and elimination, the defective and undesirable genes will gradually be uncovered and removed from the race In this way after many generations a race will have been produced all of whose individuals show the combination of characteristics sought a combination of the highest characteristics found in man (so far as none of these are incompatible with the others) The obstacles to the production of this result lie not in the theory of the matter but in its practice Obviously, however, the practical obstacles are insuperable"

Mankind would not submit to the tyranny required This type of eugenics, based upon the analogy of the domestic animals, does not lie within the bounds of practicality

Applications of Biology

The first and perhaps the most dramatic applications of modern biology have been in the prevention of disease Pasteur followed up his demonstration that spontaneous generation does not occur, with the discovery that infectious diseases, such as typhoid, diphtheria, and pneumonia, are caused by living organisms Most of these are bacteria many of the rest, like those of measles, are too small to be seen Others are of an animal nature, like the active causes of malaria and sleeping sickness Together with such discoveries arose the science of parasitology The life histories of various parasites were

unravelled, with the result that it has been possible in many cases to stamp out the corresponding disease or affection Frequently there is an association between some parasite or animal and the microscopic agent of some disease Anti typhoid inoculation, the control of diphtheria, the elimination of malaria over wide areas of the earth—these have been some practical consequences of such work No longer do we think of disease as due to evil spirits, or as magic sent by God for our punishment In such matters biology has certainly produced a very evident effect

In the economic fields of agriculture, forestry, and cattle raising the study of parasites and of the organisms of disease has proved no less important Throughout the British Dominions to day there is urgent need for zoologists and botanists, young men of enterprise and scientific training, to aid in solving important practical problems The demand is far greater than the supply At the present time, at Plymouth, a certain degree of success seems already within range in predicting the quality and the approximate locality of herring fisheries from year to year Water supply and sanitation require biological knowledge, bacteriological technique The transport of living fruit from the ends of the earth is a joint problem of *biology and engineering The freezing of meat*, the drying of milk, the preservation of eggs, the canning of fish, the safeguarding of vitamins in food, the standardising of drugs, all such matters implicitly assume a certain biological knowledge These are not unimportant things in human life Constructing Latin verse or studying Greek philosophy may be better gymnastics for the mind, but even Cabinet ministers and leader writers might find a little biology useful for an understanding of the world

It is not necessary to insist upon the close relation between physiology and medicine, the oldest almost of all sciences and arts No man has served medicine better than William Harvey, who by the vivisection, as he says, ' of toads, serpents, house snails, shrimps, crevisses, and all manner of little fishes ", together with a host of other animals, discovered the circulation of the blood—the greatest single discovery in the whole of medicine From his day downwards along the years the services of physiology to medicine, and to the alleviation of human disability and suffering, have accumulated Not many of us are doctors, but most of us from time to time are patients To understand even a little of what medicine means, of the general principles upon which it is based, to regard ourselves objectively, when we are sick, as an experiment, to think of public health, of medicine, and of surgery in concrete terms instead of as a form of magic surely if an elementary knowledge of biology can secure these things—and I think it can—it deserves a better place in our curricula Perhaps the most important service of biology is to give men a reasonable attitude towards life

Psychology

These are practical affairs In universities, however, and in schools, we study things not merely because they are practical but chiefly because they are interesting things that are interesting will be practical enough in good time In most branches of learning, we have to weigh the value of human evidence Evidence, as we know, is coloured by emotions and desires few, however, realise how often or how much Why is it that one person, or one group, inevitably draws one type of conclusion from the evidence, another draws a different? In our conscious minds we are honest, or we try to be honest, enough why, however, do we reach different conclusions from the same apparent facts? In historical matters we must often ask whether it is *not more probable that human senses were deceived*, that human judgments were at fault, than that such and such a thing ever happened at all In records of miraculous cures and of wonders of all kinds, in the tales of witnesses of accidents in ordinary life, we know how our opinion of the value of evidence must always be tinged with a certain scepticism The senses of man may be deceived, his sensations may be misunderstood or misinterpreted, his judgment—especially after the event—may be distorted by what he wishes, or thinks he ought, to believe

These are matters of human psychology and behaviour and psychology is based upon the physiology of the senses and the brain Those who have no idea of the mechanism of sensation, who believe in the absolute existence of all they see or hear or feel, who do not realise that these are simply judgments, summaries, pictures in the nervous system, of millions of nerve messages received from their peripheral sensory organs, are all too ready to be led astray into false judgments of fact Thus arise beliefs in the existence of things that do not exist at all, outside our own sensations Common superstitions, magic, spirit photographs, premonitions, all the incredible things we read even to this day in the daily Press

about omens or curses or bad luck—these would vanish into thin air were the evidence to be examined objectively in the light of what is known of the fallibility of human senses and judgment I have often thought that a university should have a professor of conjuring to demonstrate how easily we can be deceived and a reader in mental disorder to convince us how much our judgments, even of matters of fact, may be affected by our expectations, our state of health, our emotions, our desires

Psychology, to the degree that it has an objective basis, is founded upon observation and experiment on animals and men 'Behaviourism' may not be so important as some of its advocates claim conditioned reflexes may not be the origin of all our actions, as certain enthusiasts maintain psycho-analysis may invent, as well as discover, the hidden causes of our mental states Other sciences also have made grave mistakes in their youth Which among them shall first cast a stone at psychology? How often has physics discovered a complete formula for the universe? How often has the mystery of life been solved? Based, however, on the physiology of sensation, on the objective study of reflex and cerebral activity, on observation of the behaviour and development of animals and men, on the analysis of instinctive actions and intelligent reactions based on these there can be no doubt of the importance, or of the future growth, of psychology Psychology is a biological science—biological in its widest sense—and it has great gifts to bring to the other branches of human knowledge in allowing us to appreciate and understand men's motives, men's instincts, men's behaviour as individuals or in larger groups, and the various disturbances which affect their minds and conduct

We can take a more charitable view of apparently perverse behaviour if we realise that abnormal mental states are relatively common, and that desires and emotions, feelings and memories, underlie all human conduct We shall be more likely to be reasonable ourselves if we recognise the imperfections of our cerebral machinery, if we appreciate our own motives, if we understand—which is not at all easy—the origins of our actions The most humane approach to the study of human conduct, I would urge, is one which takes due account of the biological factors in humanity

Progress by Experiment

Biology in the present stage of its development is inevitably concerned with practical experiment it has not yet attained the precision of knowledge at which theoretical treatment of its problems is often of significance Physics, on the other hand, in its philosophical implications, is stretching out far into the unknown its mathematical aspects are occupying the attention of some of the greatest intellects of the age It is possible for a man to make the most important contribution to physical science, although himself quite unskilled and unversed in experiment or observation This is not yet possible in biology, nor will it be for many years to come Biological material is so much more complex, so much more difficult to fit to a decisive experiment, the number of its variables is so much greater We have to deal with an almost infinite variety of mechanisms, confined in a single living cell which may lie almost on the limits of visibility

Reflect, for example, on what our inheritance means We are in the first place human beings, not onions or elephants then perhaps we are white human beings, with red hair, blue eyes, and freckles we have physical, mental, emotional, and moral characters of all kinds we hand these on in turn to our children and our children's children through unlimited generations We do so merely by the influence of a single living cell The male cell, with all its infinite variety of mechanisms and possibilities, weighs something of the order of a one hundred millionth of a milligram Picture the whole paternal inheritance of all the people in the United States of America derived from a single milligram of material the inborn characteristics of the entire human race present on the earth to day drawn from chromosomes weighing less than a single drop of water The astronomers arouse our imagination and envy by their tales of the almost infinitely great think of all future human history, in its endless variety, depending on material weighing less than a pin, *then* we can realise that the problems of biology are not altogether easy

Vitalism and Mechanism

Much labour and much skill have been devoted for many years to the study of such highly differentiated tissues as muscles and nerves We do not pretend to explain the growth, the apparently purposeful development of these in the body Our highest aim for the moment is to understand their working Success, though meagre, has been sufficient to give us confidence that there is nothing to stop us on the road of our desire To the degree that physics and chemistry are reasonable and intelligible, so also the phenomena of life are reasonable and intelligible It is quite sure that no sentinel stands across the path to forbid our

further advance We hear much discussion of the relative philosophical merits of mechanism and vitalism both contain elements of truth, but the whole truth is neither in the one nor in the other

There is no more reason for expecting to explain life in terms of physics than physics in terms of life The powers of the human intellect alone are the limit to our understanding of either When a physical event occurs in a living cell or creature it has a physical cause, which, assuming we are skilled and clever enough, we can discover If, however, as Jeans says, all physics is ultimately mathematics and the order behind the universe is mathematical, then, mathematics being a function of one corner of the human mind, physics is ultimately physiology! Philosophically we can have it which way we like practically, in biology, we must make good and significant experiments and observations

Competition and Co operation

If we survey the totality of living things, we see two main forces at work that of competition or the survival of the fittest, that, on the other hand, of co operation in the service of the community The higher animals are communities of cells—and the cells must work together or the community will perish Man is a gregarious creature, he lived at first as a member of a family, then as a member of a tribe, more recently as a member of a nation Some day, it is certain, he will live as a member of mankind The evolution of mankind as a living organism has been extraordinarily rapid in recent years, that of man the individual is bound to be, at the present stage and hereafter, very slow Already we see, in such organisations as the League of Nations, the idea at work of mankind as a single organism, trusting not chiefly to the survival of the fittest, but to the principle of co operation The conception of mankind as a living biological unit is one of great significance for the future of the race By eugenics, so far as it is practicable—and with further knowledge it may become not only practicable but easy—we shall ensure that survival of the fittest shall continue to keep the race from degeneration, without the bloodshed and cruelty of its natural incidence By co operation we shall make certain that the malignant growths of national hatreds do not wreck an otherwise healthy organism

The Claims of Biology

I make strong claims for biology—but do not think I am advertising my own wares Indeed, if I can analyse my motives properly, I am protesting against my own ignorance of, my own lack of education in, the most interesting things in the world Had I spent a little less time at Latin and Greek, had the theory of equations and the convergence of infinite series loomed a little less large on my horizon, I might have had time, if someone would have taught me, to learn about living things at an age when they could be remembered Knowing just enough, however, to realise the wonder, the beauty, the complexity of life in its scientific sense, and the degree to which workers with every variety of mind can contribute to the living organism of biological knowledge, I have set out to urge that the claims of biology must be treated very seriously

There are not many departments of knowledge in which its contribution can be neglected, there are not many aspects of life which can remain indifferent to its teaching Nearly half a century ago died Francis Maitland Balfour, brother of Mrs Sidgwick, a man whose early promise—could it have been fulfilled—would have placed him among the greatest of Cambridge biologists Another brother, Arthur James Balfour, died recently all his life a friend, and far more than a friend, of science, even in his last years he rendered, by his counsel, very important service to medical research and to applied psychology Henry Sidgwick him self, were he alive to day, would have been one of the first to see the significance of biology, in its wider aspects, in matters of human conduct The days fortunately are gone when children had to be informed that babies are sent down ready made from heaven The stage has been passed where full grown men and women can be told that the ideas of absolute good or evil are derived from the same mysterious source Henry Sidgwick's ethics was in keeping with the point of view of to day, that the idea of good is intimately associated with the highest welfare of the race with the notion that the health, the happiness, the wisdom, the beauty of mankind as a sentient living organism must be the final arbiter in deciding what is good and right

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be the radius of a configuration, arbitrarily assigned beforehand. Let us endeavour to construct a gaseous configuration with this radius. If such a configuration be capable of being constructed, let us in imagination take a journey inwards to the centre, starting from the boundary. Let M be the total mass, $M(r)$ the 'surviving' mass left inside the sphere of radius r when we have reached the distance r from the centre. Then $M - M(r)$ is the mass already traversed. Consider now the influence of light-pressure. If L is large, light-pressure will be large and will balance an appreciable fraction of gravity, and accordingly the density gradient will be small. But if L is small, light pressure will be small, and the density-gradient will be large. Thus, when L is large, we shall have traversed a smaller mass $M - M(r)$ in the shell between r_1 and r than when L is small. Consequently, when L is large, $M(r)$ will be larger than when L is small. In other words, as we journey inwards, when L is small we 'consume our mass' faster than when L is large. If L is sufficiently small, we may have consumed our whole mass M before we arrive at the centre; in that case the only configuration of radius r_1 and mass M is a hollow shell internally supported by a rigid spherical surface. If L is sufficiently large, we shall, however, tend to have an appreciable mass $M(r)$ surviving unconsumed however near we approach the centre, and this surviving mass $M(r)$ can only be packed inside r at the cost of high density with violation of the gas laws. Thus these configurations for large L must be centrally condensed. For small L, on the other hand, no configurations of radius r_1 and mass M, unsupported, can exist, and the actual configurations must be 'collapsed' ones. 'Collapsed' configurations prove to be much more nearly homogeneous than 'centrally condensed' ones.

Scientific Centenaries in 1931

WITH the forthcoming celebrations in London in September, first of the centenary of the discovery by Faraday of electromagnetic induction and then of the centenary of the British Association, the year 1931 promises to be one of outstanding interest to men of science, especially as these events will be preceded by the Second International Congress of the History of Science and Technology, also to be held in London. At Cambridge, too, a committee of distinguished men has been appointed in connexion with the centenary celebrations of the birth of Maxwell (1831–1879). Among other famous physicists who were born the same year as Maxwell were P. G. Tait (1831–1901), D. E. Hughes (1831–1900), Sir Francis Bolton (1831–1887), a founder of the Institution of Electrical Engineers, S. H. Burbury (1831–1911), and Johannes Bosscha (1831–1911), once the acknowledged leader of Dutch physicists, while a hundred years ago died J. T. Seebeck (1770–1831), the discoverer of thermo-electricity, and Henry Foster (1796–1831), the Copley Medallist of the Royal Society in 1827. Two hundred years ago, on Oct. 10, 1731, Cavendish was born at Nice.

Among the anniversaries of 1931 of great interest to mathematicians is that of the tercentenary of the death of Henry Briggs (1561–1631), the first Gresham professor of geometry, and from 1620 Savilian professor at Oxford, an appointment in which he succeeded Savile himself. The first improver of logarithms after Napier, Briggs wrote two great works, his "Arithmetica Logarithmica" and "Trigonometria Britannica". At his death Briggs was buried beside Savile in the chapel of Merton College. Another well known name is that of Brook Taylor (1685–1731), "one of the most able British mathematicians after Newton", and secretary to the Royal Society. Baron Maseres (1731–1824), the mathematician and judge, was born the year Taylor died. Maseres, Taylor, Briggs, Burbury, Cavendish, and Tait, like Maxwell, were all graduates of Cambridge; while last century, few Cambridge mathematicians had a higher reputation than E. J. Routh (1831–1907), who shared the Smith prize with Maxwell. The year 1831 also saw the death of the remarkable French woman mathematician, Sophie Germain (1776–1831).

Of the names of astronomers recalled by the passing of a century, mention may be made of Jean Louis Pons (1761–1831), the discoverer of 37 comets; of the Rev. F. Fallows (1789–1831), the first Royal Astronomer at the Cape of Good Hope, where he died; of Edward Stone (1831–1897), who was the predecessor of Gill at the Cape; and Bredichin (1831–1904), the successor of Otto Struve at Pulkova Observatory. A very notable achievement in astronomy is recalled by the tercentenary of the observation by the philosopher Gassendi, on Nov. 7, 1631, of the transit of Mercury across the sun's disc. The occurrence had been predicted by Kepler, but Gassendi alone among his contemporaries appears to have made adequate arrangements for observing the transit, and happily his foresight and ingenuity were amply rewarded by his success.

Other distinguished men of science born a hundred years ago include the American agricultural chemist, Samuel William Johnson, whose two books, "How Crops Grow", 1868, and "How Crops Feed", 1870, were translated into French, German, Russian, Italian, and Japanese; the German chemist, Hans Heinrich Landolt (1831–1910), who was spoken of in the *Journal of the Chemical Society* as "the patriarch of physical chemistry", and the British chemists, Matthiessen (1831–1870), Northcote (1831–1869), Bloxam (1831–1887), and Atkinson (1831–1900), all of whom enriched chemical literature. The year 1831 also saw the birth of the great Austrian geologist, Eduard Suess (1831–1914), Copley Medallist of the Royal Society in 1903, whose name is now to be seen on a tablet affixed to 4 Duncan Terrace, Islington, where he was born; of Carl Albert Oppel (1831–1865), the eminent German palæontologist; of Othniel Charles Marsh (1831–1899), long in charge of the division of vertebrate palæonto-

logy in the United States Geological Survey, and the discoverer in 1871 of the first pterodactyl remains, and of Eugène Renevier (1831–1906), the distinguished Swiss geologist Swiss science is also represented by François Huber (1750–1831), the naturalist, who, though smitten with blindness, wrote a notable work on the habits of bees, British surgery is represented by John Abernethy (1764–1831), of St Bartholomew's Hospital, one of the foremost medical teachers of his time, the birth of British industrial chemistry by Archibald Cochrane, ninth Earl of Dundonald (1749–1831), who wrote an account of coal tar and established works for the manufacture of soda from common salt, but reduced himself to penury The bicentenary of the birth of Erasmus Darwin (1731–1802) will not only recall an interesting figure of the eighteenth century, but also will serve to remind us that on Dec 27, 1831, his famous grandson, Charles Darwin, left England in H M S *Beagle*

In the realm of engineering and invention many interesting centenaries will fall due Sir Hugh Myddleton, who gave London its first waterworks, died in 1631, Patrick Miller, who, with the aid of Symington, experimented with steam boats in 1788, was born in 1731, while 1831 saw the deaths of Symington himself, of Blenkinsop, a pioneer of the locomotive, of Sir Samuel Bentham, and of Henry Maudslay, probably the finest mechanician of his day The same year saw the birth of Sir Andrew Noble, the great artillerist, of Ludwig Nobel, 'the Baku oil king', of Pullman, maker of the first sleeping-car, and of James Starley, who "by his improvements rendered bicycles and tricycles machines capable of general use", and by his energy raised Coventry to the position of a centre of industry

Obituary

DR ELLWOOD HENDRICK

A *FRIEND* cannot be defined He is never made he comes, when and how who shall say? Only where the wind listeth He cannot be a woman subtle, homosexual harmonies tie the relationship He is the greatest and rarest of discoveries the inestimable loss The intensity of friendship may vary greatly waiting as it does upon opportunity for its upgrowth, ripening with time, its character is of instant determination at least, you know at once who are the people you will like

Ellwood Hendrick, almost by his name, made instant appeal to me ten years or so ago when we met at one of our summer chemical gatherings To write the common, catalogued, laudatory notice of such a man is impossible, the more as he has no base professional claim When with him I had the feeling that "Rip van Winkle" was at hand, having Jefferson's inspired presentation of the delinquent in mind– a vision unfortunately impossible to the modern generation Hendrick was a bit of a Rip and both in build and manner of Dutch complexion, with sufficient *Diable au corps*, I believe of Irish origin, to make him artist and humorist as well—no mere testubical chemist Giving avuncular advice on the study of chemistry, he could slyly write—

> You'd better join the Church before
> This course is well begun,
> Because you'll need to exercise
> The art of faith, my son
>
> I used to think theology
> Was rather rough on doubt
> But chemistry with ions beats
> Theology all out

Long an admirer of Lafcadio Hearn—the strangest of hybrids, Greek-Irish by descent—in reading his "Life and Letters", by Elizabeth Bisland (1906), I had wondered what manner of man the Ellwood Hendrick could be to whom Hearn had addressed such wonderful outpourings, even calling him 'Dear, Devilishly Delightful, Old Fellow' (in 1891) Hearn wrote his friend's epitaph in using these words This is what I at once found him to be We exchanged letters freely and it took me but a short time to fathom the secret of Hearn's love of the man The full story of this friendship was given by Hendrick, in an essay he contributed to the *Bulletin of the New York Public Library* last year, he had presented the precious originals of the Bisland letters to the Library in 1919

Hendrick tells how he first met Lafcadio Hearn, in 1888, in New York, at a select gathering of literary people, including Elizabeth Bisland—the most beautiful woman he ever saw Hearn was then on his return from two years in the French West Indies, this was a year before he went to Japan Quickly seeing how utterly miserable Hearn was in the presence of strangers, owing to his intense shyness, accentuated by his partial blindness, Hendrick soon took him away—as an old Heidelberg Corps student should, naturally to 'a none too respectable beer cellar', the only possible place of resort in the circumstances The beer fulfilled its divine appointed purpose They talked of many things In the end Hendrick resolved that here was his opportunity

> " that if this man would only let me, I would cultivate his friendship and be with him as much as I might, for it seemed as though, through him, a light was dawning on my horizon
>
> "Perhaps I had better explain a little about myself I had studied chemistry abroad and had planned to organise a great synthetic organic chemical industry in the United States It had started and proceeded for three years until we finally produced excellent materials But our sales organisation was defective, tariff changes and a bad year ensued, there arose disagreement among the proprietors, the bonds foreclosed and that was an end to it all for me I was young and foolish and resolved to have nothing more to do with chemistry which had been, I felt, a false mistress to me The dreams of my boyhood and

young manhood were shattered, I believed my future to have been destroyed, that nothing but commonplace things would be available to me and that the whole business of living was hardly worth while It was easy enough to make a living by sticking to my job but even if it did lead to a better post and more pay it lacked the distinction on which I had set my heart—and been disappointed In short, my ambition was hardly to be recognised

"I did not tell these things to Lafcadio as I have told them here but he sensed the situation And just as I resolved that night to cling to this man in the hope of enlightment, I believe he resolved to fan the almost extinct spark of ambition in his new companion, who was ten years his junior, until it might burn again and warm his disappointed soul"

Ellwood Hendrick was born at Albany, N Y, on Dec 19, 1861, he died in his New York home on Oct 29, 1930 Educated for the most part abroad, at twenty he became manager of the Albany Aniline Dye Works—it is not surprising that he was unsuccessful He then spent over thirty years in insurance work He returned to chemical work, in 1917, with the Arthur D Little Co, Cambridge, Mass In 1924, he was appointed curator of the Chandler Museum in Columbia University Of late, he exercised a great influence upon the social development of Columbia students, seeking to make them men of the world All sorts of willing helpers came to his aid—distinguished actresses and others He had a very pretty pen, as all know who have his delightful volume of "Percolator Papers" (Harper Bros, 1919), a model in its way—named after the organ of the New York Chemists' Club He could write on subjects so far apart as Saul of Tarsus and C_2H_5OH—even ascribe to the latter the greater influence for good in the world

Hendrick was a perfect letter writer Early in March of last year, he wrote me a rapturous account of "Green Pastures", the work of his friend Marc Connelly "I'm so full of it, I want to write about it to some sympathetic soul" To him it was a wonderful picture of the way in which the 'darkies' took the Bible and adjusted it to their own minds (This may not be without repercussion upon ourselves, if we consider what is the effect upon students of textbook tarradiddles and modern pseudo scientific mysticism) "It is all real from a simple and childish point of view that everybody had once I urge you to see it It is free from all the offensiveness of apologetics" His charm, in fact, lay in his being himself a primitive In "Green Pastures", Hendrick was in the element native to his spirit HENRY E ARMSTRONG

WE regret to announce the following deaths

Mr T F Bourdillon, formerly conservator of forests, Travancore, on Dec 19, aged eighty one years

Dr Geo F Freeman, director of the Federal Experiment Station at Mayaguez, Porto Rico, since April last, an authority on cotton breeding, on Sept 18, aged fifty three years

The Right Hon Lord Melchett, P C, F R S, chairman of Imperial Chemical Industries, Ltd, on Dec 27, aged sixty two years

Prof John Munro, emeritus professor of mechanical engineering at the University of Bristol, on Dec 19, aged eighty one years

Prof Pierre Termier, Inspector General of Mines and Director of the Service de la Carte Géologique, who was elected in 1909 a member of the Section of Mineralogy of the Paris Academy of Sciences, aged seventy one years

News and Views

WE have on more than one occasion had suggested to us that articles on investigations being carried on at various research centres would be of interest to scientific workers elsewhere The selection of such centres is, however, a little difficult, and the result might be regarded as invidious, unless it referred to the activities of a particular investigator and the group of workers around him After all, scientific research is peculiarly individual whether carried out alone or with the help of others It seemed to us, therefore, that an approach to investigators themselves, inviting them to state the main subjects to which they are now devoting attention or problems which they would like to see solved, might lead to some interesting and suggestive notes Inquiries, with this intention, have been sent to a number of people engaged in research, and in another column we associate replies received with the birthdays of those who have sent them It is proposed throughout the year to publish similar notes under the title of "Birthdays and Research Centres", and we believe that the information thus brought together will prove of wide interest

IN the issue of NATURE for Dec 27, under "News and Views", reference is made to "the birthday anniversaries of three veteran workers in science and educational progress" In the case of Dr William Garnett, who celebrated his eightieth birthday on Dec 30, mention should be made of his work in Newcastle and the counties of Northumberland and Durham during the ten years he resided in Newcastle upon Tyne When in 1884 he was appointed principal and professor of mathematics in the Durham College of Science in Newcastle, he found the College still in occupation of temporary premises ill adapted for its work Circumstances combined to crown Dr Garnett's insistent advocacy for the erection of special buildings, a site was acquired, and building operations begun with the north east wing, which was opened in 1888, to be followed six years later by the completion of the south east and south west wings In 1894 Dr Garnett resigned the principalship to take up the organisation of technical education for the London County Council Since that time the work in Newcastle has progressed, not only is the main building completed, but also many others have been erected on the site, in connexion with what is now known as Armstrong College Further, it was mainly on Dr Garnett's initiative that the University of Durham sought and obtained a supplementary charter, which provided for the admission of women to degrees in all Faculties save that of theology, a restriction removed later when the University was reconstituted Finally, Dr Gar-

nett took an active and prominent part in promoting and organising schemes for technical education, not alone in Newcastle, but also in the counties of Northumberland and Durham

JAN 5 is the bicentenary of the death of Étienne François Geoffroy, the French chemist and physician, who was a fellow of the Royal Society and a member of the Paris Academy of Sciences Born in Paris, Feb 13, 1672, the son of a well to do pharmacist, Geoffroy studied at Paris and Montpellier, visited various parts of France, and came to England as physician to the French Ambassador In 1707 he was made professor of chemistry at the Jardin des Plantes and later on became Dean of the Faculty of Medicine at the Collège de France He did much by his personal influence to mitigate the severity of the strife then raging between Parisian physicians and surgeons, and he was the author of a "Traité de la matière médicale" which was published after his death "Geoffroy", says Senier, "was the first to construct Tables of Affinity, in which the substances are arranged in columns, each having successively less attraction for the one mentioned first This was undoubtedly a very great advance, and led directly to the important work of Bergmann" Geoffroy's younger brother, Claude Joseph (1685–1752), also a member of the Paris Academy of Sciences, wrote some sixty memoirs on natural history and chemistry, while his son, Étienne Louis (1725–1810), a correspondent of the Institut, was the author of the "Histoire des insectes des environs de Paris" and other works

EARLY last year we directed attention to the pamphlets issued by the Safety in Mines Research Board headed "What Every Mining Man should Know" The third of these pamphlets has just been issued and has for its title "How Some Firedamp Explosions are Prevented" The pamphlet explains in simple language the various methods used to safeguard against gas explosions (to use the phrase of the pamphlet itself) It would perhaps have been wiser to have spoken everywhere not of a safeguard against gas explosions but of minimising the danger of gas explosions, because it cannot be too often repeated that no invention yet produced is an absolute safeguard against explosions, but that the various modern methods described in this pamphlet do make explosions of firedamp far less likely to occur It is needless to say that the pamphlet is well and clearly written, but it may be doubted whether it will really accomplish its desired end First of all, as has already been pointed out, it is doubtful whether any large number of coal miners will even take the trouble to read these pamphlets In the second place, it will be seen from the Annual Report of H M Chief Inspector of Mines for 1929 that in that year there were 68 explosions of firedamp causing accidents, of which no less than 50 were caused by the use of naked lights It is obvious that until the prohibition of naked lights in collieries is carried much further than it is at present, explosions of firedamp are bound to occur Nevertheless, it is obvious that the more widely information such as that contained in the present pamphlet is disseminated among coal miners the greater is the probability that the men themselves will learn to take efficient precautions against such occurrences

THE Report of the Science Museum for 1929, recently published by the Board of Education, contains statistics of the number of visitors, particulars of the progress of the various departments lists of acquisitions and their donors, and the report to the Board of the Advisory Council, of which Sir Hugh Bell has for many years been the chairman That the popularity of the Museum has increased during the last few years, and especially since the opening of the new galleries in Exhibition Road, is well known The efforts made to meet the public taste have indeed been so successful that at times the galleries have been inconveniently crowded Attendance charts included in the Report show, as might be expected, three peaks coinciding with the school holidays at Christmas, Easter, and August, when the Museum is thronged with boys and girls The working models, a feature the Museum owes to the late Mr Isaac Last, have always proved attractive, and though it may be doubted that the working of, say, the Rateau steam turbine, is understood by many who turn it round, there are simpler exhibits which the young can understand With reference to this, the Report says "A most interesting and instructive series of working models, within the range of their intelligence, could be designed and exhibited in a special gallery or galleries, which would serve as an introduction to the exhibits in the main galleries" There is no room at present for such a collection, but a commencement has been made with the construction of the models required

THE question of further accommodation at the Science Museum is referred to several times in the Report, which states that it is not possible to exhibit certain objects or develop some of the collections, owing to the want of space About seventeen years ago, the late Sir Francis Ogilvie read a paper on the Science Museum to the Royal Society of Arts, and this, when published, contained a plan of the new buildings as suggested by the Departmental Committee on the Science Museum and the Geological Museum The plan showed a range of buildings extending from Exhibition Road to Queen's Gate Had the War not intervened, no doubt the whole of this scheme might by now have been well advanced But so far only one of the three sections has been erected When the great advances made during the last quarter of a century in physical science, engineering, and technology are taken into consideration, we are not surprised that the growth of the collections has outstript the growth of the Museum buildings The new Geological Museum is now being constructed, and it is to be hoped means will be found for carrying on with the second section of the Science Museum In its scope, the Science Museum reflects very fully the great industries on which the material progress of Great Britain depends, and at the same time recalls the work of the great pioneers who made

us, at one time, the engineers and manufacturers for the whole world It is of the greatest value for technical men, teachers, and students to be able to study both past and present practice, as they can do at the Science Museum, while the importance of the Museum as an educational institution is proved by the use made of it by the schools of London and elsewhere

HITHERTO European broadcasting has been very successful in avoiding interference between the waves from transmitting stations, but recently there has been serious interference between London Regional, Mühlacker, Graz, and what is apparently a harmonic from the Warsaw station This is due partly to the small space in the broadcasting spectrum allotted to each of the transmitting stations and to the very high powers now being radiated into space by some of them, but it is mainly due to the fact that the European broadcasting conferences have not the power to control and dictate to the transmitting stations Some of the countries, also, do not respond to their recommendations Luckily, happy relations hold between the broadcasting authorities, and so a remedy for the Muhlacker interference—which has sometimes taken away nearly all the pleasure of listening to the London Regional transmission in the south of England—will be devised The power at present emitted from Muhlacker is 70 kilowatts, and as it is proposed to double it in the future, the necessity of preventing interference is urgent Judging from the number of very high power transmitting stations at present being erected in Europe, it would be well for the broadcasting authorities to look ahead and take steps to avoid interference In this respect Europe is not so happily situated as the United States, where there is a central authority appointed by the Government which can dictate to and control the various transmitting stations In the States, also, there is no risk, as in Europe, of disagreement between two nations on political issues

THE section for scientific and optical instruments and photographic apparatus at the British Industries Fair, Olympia, London, Feb 16 27, will occupy some 6000 square feet on the ground floor of the Grand Hall A joint exhibit has again been organised by the British Optical Instrument Manufacturers' Association There will be instruments for all branches of research and industry and for educational purposes, including a particularly fine exhibit of visual aids to teaching It is, perhaps, not generally known that British manufacturers of optical glass supply lenses to America for cinema cameras and projectors, and that one firm is actually exporting the bulk of its spectacle lenses to the United States Every kind of modern optical instrument is obtainable from British manufacturers, and there are some British instruments not made elsewhere which are used all over the world, including Germany There will be a novel display of marine and aerial lighting equipment, including a flashing buoy-light and aerodrome floodlights and models of lighthouses and airway beacons The section for chemicals at the Fair will occupy some 11,000 square feet on the ground floor of the Grand Hall Invitations to the Fair may be obtained by scientific workers, teachers, and others on application to the Department of Overseas Trade, London, which entitle the holder to travel to and from the Fair by rail at the rate for a single journey plus a third

A DEMONSTRATION of the work being carried out in radiology by the Radiological Branch of the Research Department, Woolwich, was given on Dec 18 and 19 The items were demonstrated by members of the staff, and a general summary was delivered afterwards by the director, Mr V E Pullin Among the items demonstrated were the following —Exhibits illustrating the technique in the preparation of radiographs of metallic objects, the designs and construction of experimental X ray transformers, together with their accessory apparatus, an experimental X ray equipment designed to work at 250,000 volts, with either valve or mechanical rectification, and with or without smoothing condensers, oscillograph studies of the current and voltage wave forms in an X-ray circuit, the construction of experimental X ray tubes up to 300,000 volts, apparatus for the radiographic examination of gun tubes and similar heavy forgings demonstrations of X ray crystal analysis of steel by means of line spectra, where precision measurements to an accuracy of one in a thousand were shown, also X ray analysis of explosives and propellants, together with new designs of X ray spectrum apparatus A large number of guests, both from the Services and outside academic and industrial organisations, were present

IN a communication elsewhere in this issue, Dr V F Hess again raises the question of whether part of the cosmic radiation may come from the sun There can be no question that any solar component is very small, and that the accuracy of most of the older measurements would not have sufficed to show its presence Dr Hess considers, however, that this is established by recent work of Hoffmann and Lindholm with a large high pressure apparatus, which has been used at a height of 2456 metres at Muottas Muraigl, in the Engadine These observers found consistently that the ionisation due to the penetrating rays was about one half per cent greater by day than by night, and, moreover, that the absorption coefficient of the difference in ionisation was about the same as that of the whole of the cosmic radiation Dr Hess takes the view that it is legitimate to suppose that the difference represents the contribution of the sun, and that the absorption measurements show that this is at least as hard as the main radiation Corlin's conclusion—based on a statistical analysis—that the sun is not a radiator, is referred to lack of precision in the data employed by him If Dr Hess's views prove to be correct, and the sun, and so presumably all stars, are to be regarded as sources of the rays, it will become desirable to reconsider critically the alternative view that they arise in interstellar space

CONSIDERABLE interest and no little controversy was aroused in America in 1927 by the announcement

that Mr Harold Cook had discovered metates for grinding corn and an arrowhead in association with fossilised mammalian bones of Pleistocene age in the Holloman gravel pit at Frederick, Oklahoma In view of the verdict passed on similar discoveries which have served as a basis for a claim for a high antiquity for man on the American continent, it is not surprising that the announcement was received with considerable reserve, and the conclusion that the Oklahoma gravels afforded evidence of the contemporaneity of man and a Pleistocene fauna in America was questioned by more than one anthropologist of standing The accuracy of the interpretation of the geological evidence by Mr Harold Cook and others is now disputed by Dr O F Evans, of the University of Oklahoma, in a communication to the *Journal of the Washington Academy of Sciences*, vol 20, No 19 Dr Evans, in the light of his wide experience of the geology of the region, maintains that the gravels of the Holloman pit are a redeposit made after a period of post Pleistocene uplift, having been eroded by a stream in the bed of which the pit was situated This stream was diverted shortly after the redeposit was made The artefacts which were found in association with the fossilised bones had been lying on the surface of the gravels when the latter were eroded, and were redeposited with them Dr Evans's citation of similar deposits in the adjacent area supports his view, to which the relatively recent character of the artefacts—in any case, an element of doubt—gives further cogency Once more 'indisputable' evidence for Pleistocene man in America has failed to carry conviction

THE sixteenth meeting of the International Geological Congress will be held in the United States in 1932, with headquarters at Washington A series of excursions, to occupy about ten days late in May, is being arranged to precede the general sessions these will be partly in the north east, to suit the convenience of those arriving at New York, partly in the southern States, starting from Washington, and in addition there will be a transcontinental trip for those landing at San Francisco The Organisation Committee is planning the preparation and publication of a monograph on the petroleum resources of the world, and papers on this subject will be conspicuous in the programme of the general sessions The latter are provisionally fixed for the early part of June Other topics proposed for special consideration include estimates of geological time, problems of batholiths and metalliferous deposits, sedimentation, geomorphology of arid regions, and fossil man Suggestions for other topics are invited, and should be sent to the General Secretary After the general sessions, two alternative transcontinental excursions are proposed, each occupying 32 or 33 days, and two shorter excursions, one to the iron and copper districts of the Lake Superior region (13 days) and the other to Oklahoma and Texas (10 days) If desirable, the latter may be transferred to the group of excursions preceding the general sessions, in order that petroleum geologists may not be excluded from one of the transcontinental trips Excursions to Alaska and the Hawaiian Islands are also under consideration, and will be arranged if a sufficient number of visitors express the intention of taking part All inquiries should be addressed to the General Secretary of the Organising Committee, Sixteenth International Geological Congress, Washington, D C

THE first annual report of the Executive Council of the Imperial Agricultural Bureaux has been published Eight bureaux dealing respectively with soil science, animal nutrition, animal health, animal genetics, animal parasitology, plant genetics (crops and herbage plants being considered separately), and fruit production were set up in 1929 under the directorship of the heads of the research institutes in Great Britain at which they are located The chief officer, however, in almost every case has had training or experience in some part of the Empire overseas The main function of the bureaux is to act as clearing-houses of information in that branch of agricultural science with which they are concerned, and to promote direct contact with research workers overseas Arrangements have been made for the collection of research information from all parts of the world and for summaries to be disseminated to all workers in the Empire Although the first year was necessarily devoted largely to organisation, several of the bureaux have already been able to make a start in the distribution of the information they have collected Research work is not undertaken by the bureaux, but they are able to put workers in different countries encountering similar difficulties into touch with each other, and thus aid co operation As regards finance, all the Empire countries represented on the Executive Council contribute a share to a common fund A sum of £20,000 was originally suggested as the total yearly contribution, and estimates for next year amount to £19,300 Each bureau is being encouraged to develop along its own lines, but although there may be diversity of detail they all have a common object—service to the workers on agricultural science in the Empire The success of the bureaux, however, depends on the measure of support given by the research workers and the use they make of them

AN Association of International Patentees, Incorporated, with headquarters in New York and corresponding secretaries in various parts of the world, has recently been formed Its objects are to care for the interests of patentees and their congeners, to promote improvements in patent law, to help patentees to find financial support, to organise exhibitions and conferences, and to supply information The movement is at present mainly centred in the United States, though it aspires to become international Its vice-presidents include eleven ministers of various nations accredited to the United States, Dr Hugo Eckener, Prof Einstein, and two distinguished representatives of Canada and British Honduras The advisory board is drawn from England and the United States, the committee on scientific and educational research from Canada and the United States, and the advisory committee on patents from foreign diplomatic representatives accredited to the United States National councils are in process of formation in other parts of

the world The success of such a body in exerting international influence and in attaining its objects—particularly the notoriously difficult one of finding financial support for struggling inventors—must depend mainly on the personality and enthusiasm shown by its more active promoters, and the probable extent of its success can scarcely be predicted at this early stage

PLANS for a new building at the Massachusetts Institute of Technology contain unusual provisions for fundamental research and advanced instruction in physics and chemistry Funds for starting the building, which will join two wings of the present buildings on the east side of the main buildings, are available from the gift of £500,000 by Mr George Eastman in 1916 The new four story structure will include a well-equipped shop for the construction and maintenance of instruments, a lecture room, and a joint library and reading room for the use of the staff and students in physics and chemistry The research rooms have been designed to permit of great flexibility The construction specifications call for a structure of unusual rigidity with foundations of heavy reinforced concrete to aid in eliminating vibration An additional separate spectroscopic laboratory will be housed in a building which will occupy a site in the quadrangle formed by the new physics building The two floors of this laboratory will be supported on a foundation entirely separate from that of the outer walls and the roof of the building This foundation is to be more than three feet thick, and composed of alternate layers of sand, felt, transite board, ground cork, and reinforced concrete These elaborate precautions are expected to eliminate shocks and vibration from industrial processes in the neighbourhood and the movement of traffic on adjacent highways Provision will also be made for maintaining extreme constancy of temperature in this laboratory The equipment will include apparatus which has been collected at Leland Stanford University by Prof G R Harrison, who this year joined the staff of the Massachusetts Institute as Director of the Research Laboratory of Experimental Physics Plans for a cryogenic laboratory for fundamental studies in the science of low temperatures are also under consideration The main physics building is being designed by Messrs Carlson, of the architectural firm of Coolidge and Carlson, and the spectroscopic laboratory by the engineering firm of Charles T Main, Inc

ACCORDING to an article in *Paper Making and Paper Selling*, which has been reprinted by the New Northfleet Paper Mills, the process of making vegetable parchment by immersing suitable paper in sulphuric acid was discovered by W E Gaine in England in 1853 After later investigations by the German chemist, A W Hofmann, and the development of machinery, enabling the production of parchment to be carried out as a continuous process, by a Bohemian paper-maker, Robert Fritsch, the manufacture of parchment developed almost exclusively on the Continent, and within a few months of the outbreak of War the parchment required for the packing of food stuffs for the British Army and Navy was practically unobtainable Since the War, under the initiative of Mr William Harrison (chairman of the Inveresk Paper Company), the British Vegetable Parchment Mills, at Northfleet, Kent, have been established, and this account of their activity, issued by the mills, is printed on imitation Japanese vellum made by the mills and accompanied by a range of samples of British parchment which seems to show that the technique of the production of this valuable product upon a commercial scale is now fully mastered

THE October issue of *Isis*, the International Review devoted to the History of Science, contains an article by the editor, Dr G Sarton, on the discovery of the dispersion of light and the nature of colour The first three pages are devoted to an account of pre Newtonian work, including Markus Marci's decomposition of white light by a prism and his proof that the rays so obtained did not change their colour, and Grimaldi's suggestion that the colours were due to different undulations The next thirteen pages are occupied by a facsimile reproduction of Newton's "New Theory about Light and Colours", which was published in the *Philosophical Transactions* of the Royal Society for Feb 19, 1672 Last year the September issue contained Dr Sarton's article on the discovery of the law of conservation of energy, with facsimile reproductions of Mayer's "Bemerkungen uber die Krafte, etc", in the *Annalen der Chemie und Pharmacie* for 1842, Joule's "Calorific Effects of Magneto Electricity and the Mechanical Value of Heat" in the Report of the British Association for 1843, and a page of Carnot's manuscript written between 1824 and 1832 The comments on the controversy as to the relative values of the contributions of Mayer and Joule sum up the position judicially

SOME months ago the Royal Horticultural Society asked for information about portraits of certain eminent horticulturists and botanists to complete a supplementary volume to *Curtis's Botanical Magazine*, which will contain the photographic reproductions of the portraits and biographical notices of those to whom the volumes were dedicated (one hundred in all) All but one of these portraits have now been traced The portrait required is that of the Rev John Clowes (1777–1846) He was born at Broughton Hall, near Manchester, was a member of Trinity College, Cambridge, and a fellow of the Collegiate Church, Manchester (now the Cathedral) He gave up the benefice on succeeding to the family estates in 1833 In his time he was a prominent orchid amateur, and his fine collection of orchids was left by will to the Royal Botanic Gardens, Kew He should not be confused with the famous Swedenborgian of the same name, whose portrait now hangs in Chetham's Hospital, Manchester, and who died in 1831

NAUKA POLSKA (Science and Letters in Poland), published by the Institute for the Promotion of Science and Letters in Poland (J Mianowski Funds, Warsaw, Staszic Palace, 1930), is a periodic publication, the first volume of which appeared in 1918 It is devoted to general information about the progress of

science and the arts in Poland and abroad, although the Polish side is naturally the dominating feature Unfortunately, the whole of it is published in Polish without even short summaries in any other European language, thereby decreasing its value as a means towards international co operation Of the two volumes published last year, Vol 12 contains a complete list of all archives, museums, libraries, and scientific institutions and societies in Poland, with a concise account of each Vol 13 contains some articles of general interest and special articles on the organisation of learning in several European countries There are also included news of scientific activities both in Poland and abroad, reviews of new books, and bibliographies of sociology and the history of science (1928–30)

DR R S TAYLOR, Principal Medical Officer, Somaliland, reports the occurrence of no fewer than eighteen earthquake shocks which were experienced at Zeila (11° 20′ N , 43° 30′ E) between Oct 24 and Oct 28 One shock occurred on Oct 24, two on Oct 25, twelve on Oct 27, and three on Oct 28 No details of times or intensities are given, but the shocks were probably slight and local only , nevertheless, the report is of interest, because Somaliland is not an 'earthquake country', and earthquakes are very rarely experienced there

THE following have been elected officers for the year 1931 of the Canadian Phytopathological Society *President*—W P Fraser, University of Saskatchewan, Saskatoon, Sask , *Vice-President*—D L Bailey, University of Toronto, Toronto, Ont , *Secretary-Treasurer* —T G Major, Tobacco Division, Central Experimental Farm, Ottawa, Ont

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A physics master at Cowley School, St Helens—The Secretary for Education, Education Office, St Helens (Jan 13) A research assistant in the physical chemistry department of the University of Leeds—The Registrar, The University, Leeds (Jan 14) An assistant lecturer and demonstrator in chemistry in the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Jan 14) A sewage works chemist in the surveyor's department of the Urban District of Dagenham—The Clerk of the Council, Council Offices, Valence House, Chadwell Heath, Essex (Jan 17)

Our Astronomical Column

Astronomy in Virgil —Mr S B Gaythorpe appropriately celebrates the Virgil bi millenary by a paper in the November issue of the *Journal* of the British Astronomical Association on the astronomical allusions in his poems He notes that Anchises places astronomy high among the arts that make a nation glorious "With the rod they will trace the paths of heaven and tell the rising of the stars" ("Aen " VI) There is a well known problem as to who was intended by Virgil for the unnamed companion of Conon "Who marked out with his rod the whole heavens for man " ('Ecl " III) Many astronomers' names have been suggested, but Mr Gaythorpe suggests that the allusion is simply to the unknown man who first divided the heavens into constellations

Most authorities have assumed that Virgil was quoting from some work that was ancient even in his days when he spoke (in "Georgic " I) of the Bull opening the year with his golden horns Mr Gaythorpe notes that there is a sense in which it was true in his own times In mid April Aldebaran could have been seen to set heliacally, with the horns of the Bull plainly visible in the twilight, and Sirius (also mentioned in the poem) farther to the left It is clear that Virgil recognised the practical use of such observations for regulating the times of sowing and other agricultural operations Mrs Evershed, in a companion paper, notes that Dante, in the "Inferno " and "Purgatorio ", makes Virgil give accurate information on many points of astronomy Virgil seems, however, to have made an error about the southern hemisphere, thinking that its inhabitants reversed not only summer and winter but also night and day , "When dayspring comes to us, there Hesperus kindles his lamp " ("Georg " I) In the corresponding passage in Dante, the travellers have emerged at the antipodes of Italy, so the reversal of night and day comes in correctly there.

Spectrum of β Lyræ —A detailed analysis of the spectrum of this extraordinary star was undertaken at intervals by the late Mr F E Baxandall during the last ten years of his life, and the results of his study are now given in the *Annals of the Solar Physics Observatory of Cambridge* (edited by Prof F J M Stratton) Two series of spectrograms taken at Cambridge, together with an earlier series kindly lent by the Allegheny Observatory, form the basis of this investigation, which adds many details to our knowledge of this stellar system, without, however, deciding conclusively its physical nature The absorption spectrum is apparently of dual origin—an oscillating *B*8–type spectrum, and one of type *B*5, which, though not stationary as previously thought, shows only slight radial velocity variations There is also a suggestion of a third source of absorption lines which may be of the nature of a Trojan planet Contrary to earlier hypotheses, the *B*5 star is apparently smaller and more massive than the *B*8 star, but is surrounded by an extensive gaseous envelope which is responsible for the bright lines Several outstanding anomalies still remain unexplained, but the memoir is a valuable contribution to the subject, and forms a fitting memorial to the labours of its originator

Two more Trojan Planets —The Trojan group of minor planets is growing rapidly Odysseus was discovered some months ago, and two more Trojans are announced in *U A I Circ* No 307 These were discovered at Königstuhl on Oct 17, and designated *UA* and *UB* 1930 Using arcs of six weeks, Drs Kahrstedt and Stracke have deduced orbits that indicate periods so close to that of Jupiter as to justify the designation of Trojans The period found for *UA* is about a year longer than that of Jupiter, but it cannot yet be considered as accurately known There are now five Trojans (including Odysseus) the longitude of which exceeds that of Jupiter by about 60°, and four (including *UA* and *UB*) on the other side of Jupiter The eccentricity of *UA* is given as 0 29, so that it is nearly twice as far from the sun at aphelion as at perihelion The magnitudes of both planets are about 14½ The interesting planet 944 Hidalgo, which travels out almost to Saturn's orbit, is now returning sunward, and an ephemeris is given for next July in "Kleine Planeten ", but as the magnitude is only 18½, it will probably not be detected until the following year Its orbit is quite cometary, but its aspect has always been stellar

Research Items.

Healing in Ontong Java.—Measures taken for healing the sick in Ontong Java (Lord Howe's Island) in the Western Pacific are described by Mr. H. Ian Hogbin in *Oceania*, vol. 1, No. 2. Disease, in common with the weather, success in fishing, sorcery, and a hundred other things which affect the daily life of the people, are caused by *Kipua*. Every individual soon after birth receives a *kipua* (spirit), a double or airy body invisible to ordinary eyes. Although a *kipua* is not closely attached to its owner, it is not free until he dies. It then becomes free, and only then can it interfere in the ways mentioned, in the lives of other people. Illness being caused by the *kipua* can only be treated by ceremonies addressed to the *kipua*. An exception is made in the case of boils, contusions, ringworm, malaria, sprains, and swelling of the limbs, which are treated by natural means. The more serious diseases are classified; two classes, convulsions and paralysis, are regarded as incurable; but each of the remaining classes has its own specialist. The remedies are the property of certain joint families and are transmitted from headman to headman. An essential factor in the healing is a *pule* (cowrie) shell to which unbroken white coconut leaf, pandanus leaf, and a piece of the healer's hair are tied. The first essential is to find out which of the *kipua*, usually the spirits of the man's own ancestors, wish him to live and which wish him to die. Two methods are simple and may be carried out by anyone. The question being put to the *kipua*, the answer is given by knots made in strips of coconut leaf or by small pebbles. The more elaborate method requires the service of the specialist, a medium. When the sick man and his relatives have repaired to the house of the medium, the latter is possessed by each of the *kipua* invoked in turn, who states through him its wish. When the name of the *kipua* responsible has been ascertained, a ceremony follows, in the course of which the *kipua* is besought by prayer to give good things instead of evil.

Spread in British Isles of Black-necked Grebe.—The disappearance of the black-necked grebe (*Podiceps nigricollis*) as a British breeding bird was connected with the drainage of the fen area, but its recent re-establishment and spread shows an adaptability which makes it surprising that it should ever have become extinct. In 1904 it was first discovered to be breeding in Wales, in 1915 in a western lough in Ireland, in 1918 at Tring Reservoirs, and a few months ago C. G. Connell recorded the nesting of at least two pairs in a loch in the Forth area of Scotland (*Scottish Naturalist*, p. 105, 1930). Now C. V. Stoney and G. R. Humphreys have found in western Ireland a colony which they estimate to consist of about two hundred and fifty pairs, and that in a lough not more than two or three miles long and half a mile wide (*British Birds*, vol. 24, p. 170). It has been assumed, in regard to the spread of the black-necked grebe, that the colonists in the British Isles were immigrants from the Continent, where the species breeds in countries no farther away than Denmark, Germany, and Livonia. But the presence of the large Irish colony makes it possible that the new breeding places may have been peopled from the west rather than from the east.

Intestinal Protozoa of Wild Monkeys.—Robert Hegner and H. J. Chu (*Amer. Jour. Hyg.*, vol. 12, pp. 62-108, July 1930) report on an examination of forty-four wild Philippine monkeys, *Macacus philippinensis*, twenty-eight males and sixteen females, to determine whether they are parasitised with intestinal protozoa, and to compare these with species that occur in man. Cysts of *Entamœba histolytica* were not abundant and were mostly uninucleate. *E. coli* was found in twenty-two of the monkeys, and *E. gingivalis* in thirty-seven. *Endolimax nana* was present in twenty-two monkeys and *Dientamœba* in two (this is the first record from the monkey). Three species of *Trichomonas* were recorded. *Giardia lamblia* is a fairly common inhabitant of the duodenum and *Chilomastix mesnili* was present in fifteen monkeys. *Balantidium coli* was obtained from eight of the monkeys and showed great variation in size, probably due to racial rather than to specific differences. The authors consider that the evidence afforded by this investigation is "insufficient to separate as distinct species the eleven types of protozoa described from wild Philippine monkeys and the corresponding eleven types that live in man."

Observations on Living Tissues.—Prof. Eliot R. Clark and his colleagues in the Department of Anatomy of the University of Pennsylvania have recently developed a method of studying the living tissues of the rabbit's ear (*Daily Science News Bulletin*, Science Service, Washington, D.C.). A double-walled chamber or window, one wall being of celluloid or glass and the other a very thin sheet of mica, is so arranged on the ear of a rabbit that a thin layer of tissue is enclosed between the two walls of the chamber and can be examined microscopically. As the chamber can remain in place for months, the same area of tissue can be repeatedly observed and the details of the blood circulation studied; and in specially thin tissue, which can be examined with an immersion lens, the growth of cells and of capillaries can be followed day after day. The method will be of value also for the study of transplantations and of the reactions of tissues to different conditions.

Fungi in Butter.—Grimes, Kennelly, and Cummins have carried out an examinaton of butter samples taken with all suitable antiseptic precautions from the interior of a 56 lb. sample which had been kept at low temperature for two weeks, since it was packed at an Irish creamery. The cream is pasteurised, and none of these moulds was found to survive the temperature of pasteurisation. It is concluded that they have probably entered the butter either from the churn or the air (many creameries are near the road side, which increases the risk of contamination from this source). A list of twenty-nine moulds found in the butter is given in the *Scientific Proceedings* of the Royal Dublin Society, vol. 19 (N.S.), October 1930, and the authors note that many of them appear to deviate a little from the standard type of their species, which they think may be due to a process of development of insular strains, peculiar to Ireland.

Climatic Changes during the Pleistocene.—Dr. G. C. Simpson deals very fully with this still tantalising subject in the *Proc. Roy. Soc. Edinburgh*, **50**, pt. 3, No. 21, pp. 262-296, 1930. It is assumed that the glaciation of northern Europe during the Pleistocene was due to a shift of the pole associated with appreciable variations of solar radiation. The shift of the pole brought Europe into sufficiently high latitudes to permit the formation of an ice-sheet, but the variations of climate, such as are shown by the inter-glacial epochs, were due to the oscillations of solar energy. With two complete cycles of solar radiation it becomes possible to account for four advances of the ice. The Günz-Mindel and the Riss-Würm inter-glacial epochs occurred at the maxima of solar

radiation and were therefore warm, they were periods of increased precipitation in all parts of the world, corresponding to the two pluvial epochs which are known to have occurred during the Pleistocene. The Mindel Riss interglacial epoch is correlated with a minimum of solar radiation and it is therefore regarded as having been relatively cold and characterised by low precipitation. The sequence of vegetation types accompanying the climatic changes from maximum to minimum are park land, forest, tundra, grass with sparse trees, and steppe. The deductions are supported by the geological and archæological evidence available, and in particular it is possible to arrange the sequences of human culture, of the geological strata of East Anglia, and of the history of the ice age in the Alps into the inferred scheme of climatic changes.

Steam Tables. The August issue of the *Journal of Research* of the Bureau of Standards, Washington, contains an account of the determination of the thermal properties of saturated water and steam from 0° C. to 270° C. by Messrs. N. S. Osborne, H. F. Stimson, and E. F. Fiock, and a critical review of the measurements of these properties now available by Mr. E. F. Fiock. The determinations were made by electrically heating in a closed vessel a sample of the fluid at one saturation state until it attained a second saturation state, and measuring the electrical energy necessary. The results are expressed in tables of heat content of liquid, latent heat, heat content of vapour, in international joules per gram, of entropy of liquid and entropy of vapour in international joules per gram per degree Centigrade, for each 10° C. from 0° C. to 270° C. The results of the critical review of existing data are embodied in charts of the same quantities, and they show that from 0° C. to 100° C. the published steam tables agree with each other within the limits of tolerance of the International Skeleton Steam Tables of 1929, but that at higher temperatures several of the tables give figures which lie well outside these limits.

Thunderstorms and Penetrating Radiation.—The idea has been entertained that part of the penetrating radiation (or 'cosmic rays') might be due to the action of the large fields known to exist in thunderstorms. Prof. Millikan was, however, unable to obtain any evidence for this, and a new investigation by a different method, described by B. F. J. Schonland in the December number of the *Proceedings of the Royal Society*, confirms Prof. Millikan's result. On the contrary, it has been shown by Dr. Schonland that a *reduction* in the intensity of the radiation takes place when there is an active thunder cloud overhead, the effect being greatest for those clouds for which there was evidence that the upper positive charge was in excess. The quantity of water in the clouds is quite inadequate to account for the screening, which must be attributed to their electrical fields. From Dr. Schonland's discussion of his results, it appears that the upper limit to the energy of most of the quanta or corpuscles which make up the penetrating radiation must be less than 5×10^9 electron volts, a number which is reasonably consistent with the penetrating power of the rays. Dr. Schonland's results do not show definitely the nature of the primary radiation, but indicate that it consists either of ultra gamma quanta or of positively charged particles.

Energy Losses of Electrons in Carbon Monoxide.—Study of the energy losses of electrons in a gas, although yielding far less precise information than can be obtained spectroscopically, affords a valuable check on data obtained by the latter method, particularly in the matter of the probability of certain types of transitions. An investigation of the motion of electrons in carbon monoxide, described by Dr. E. Rudberg in the December number of the *Proceedings of the Royal Society*, shows that the important characteristic losses in this case correspond to 8.19, 11.17, 13.14, and 16.72 volts. The first two of these can be identified fairly closely with transitions of the molecule from the fundamental state, which is simple ($^1\Sigma$), to other singlet states, indicating that such rearrangements of the molecule, under this particular stimulus at least, are more probable than transitions from the fundamental singlet state to the other well known triplet states. The transitions are not, however, those which correspond to the minimum vibrational energy of the higher state, but to rather higher vibrational energy, in general accord with the principle that the change in the separation of the nuclei of the diatomic molecule is small in such cases. The other two losses of energy probably correspond to transitions to a higher (G) state, of which little is known, and to a state of the ionised molecule, respectively. Dr. Rudberg also gives data for the characteristic losses in carbon dioxide, but in this no correlation with spectroscopic data is possible, as the spectrum of this gas is as yet almost unknown.

Proteolytic Enzymes of *Carica Papaya*.—Nag and Banerjee (*Trans. Bose Research Institute*, Nos. 18 and 20, 1930–31) find that two proteolytic enzymes can be separated from unripe papaw fruit by shaking the expressed juice with kaolin and centrifuging. The liquid then contains an 'ereptase' which digests Witte peptone but not fibrin, while from the kaolin sludge can be extracted with salt a 'peptase' acting on fibrin but not on peptone. On the basis of these findings, the authors criticise the view of Grassheim that papain is a single tryptic ferment and agree with Vines that two enzymes are present.

Configuration of the Benzilmonoximes.—Experiments on the solubilities of the α- and β-monoximes of benzil in benzene are recorded in the October number of the *Journal of the Chemical Society* by T. W. J. Taylor and M. S. Marks, and the results are said to support the configurations for these compounds given by Meisenheimer. The argument is based on the assumption that the α-oxime in physical properties should be a hydroxylic substance, whilst in the β-oxime the typical hydroxylic physical properties should disappear, together with the assumption that the solubility of a hydroxylic substance is less than the 'natural' value calculated from the melting-point and latent heat of fusion. The Beckmann transformation, in this case at least, thus involves the groups in the *anti* position to one another.

Intensive Drying.—Some experiments on the vapour pressures of intensively dried benzene, described in the November number of the *Journal of the American Chemical Society* by E. J. Green, show that benzene which has been dried with phosphorus pentoxide in a fused glass apparatus for three years does not exhibit any change in vapour pressure with respect to the normal liquid in the same apparatus. Experiments are described which support the theory that the vapour pressure differences from the normal state may be explained by assuming the presence of minute traces of water vapour in the normal liquid rather than any catalytic effect due to the removal of water from the dried liquid. Calculations from solubility data show that only 0.000229 gm. of water is required to produce a partial pressure of 7 mm. of water in 1 gm. of benzene at 20°, whilst Raoult's law would require 405 times more water.

Geo-electrical Prospecting by A C Bridge Methods *

By A B BROUGHTON EDGE

ELECTRICAL methods of exploring for mineral or for investigating geological structures are numerous, but with few exceptions they fall into two groups, according to the manner in which the ground and the concealed conductive bodies lying within it are excited, and how the resulting electrical field is investigated

(i) *Surface Potential Methods* —In these, direct or alternating current is passed conductively through the ground between earthed electrodes spaced up to a mile or more apart The prospecting operations consist in determining the resulting distribution of potential in the ground and in interpreting the geological significance of any anomalies that are recorded

(ii) *Electromagnetic Methods* —In these, the ground is excited inductively by means of loops of insulated wire suitably disposed on the ground surface and carrying alternating current, usually at a frequency between 200 and 60,000 cycles per second The survey is then carried out with portable search coils, by means of which investigations are made of any anomalies that appear in the magnetic field

The object of the present article is to describe two methods of using a form of A C bridge (ratiometer) for electrical prospecting purposes, one of which comes under the first and the other under the second of the two groups that have been defined above The general principle, which is that of the ordinary A C bridge, was first applied by the author in 1925 to surface potential surveys carried out in Rhodesia The method was afterwards used in Australia by the Imperial Geophysical Experimental Survey, and from it the A C potential ratio method and instruments in the forms described below were developed

FOR DETERMINING SURFACE POTENTIALS

In order to explain the advantages of the A C potential ratio method it is necessary to refer to the well known equipotential line system which, hitherto, has been the only generally known means of investigating A C surface potentials Although the tracing of equipotential lines over the surface has the advantage of simplicity, it also has a serious defect, since it takes no account of the complex phase conditions that arise when alternating current is applied to ground of variable conductivity In such circumstances the resultant field has an *elliptically polarised* structure, in which true equipotential points can only have an instantaneous existence Although the conception of equipotential lines in such an alternating field is theoretically unsound, the out of phase effects met with in practice are not so great as a rule as to preclude the mapping of lines from which a general idea of the conductivity conditions can be obtained It often happens, however, that a survey of this kind becomes a very slow and inexact performance, and sometimes, when in the neighbourhood of important conductive bodies, the phase conditions are such that the method breaks down completely

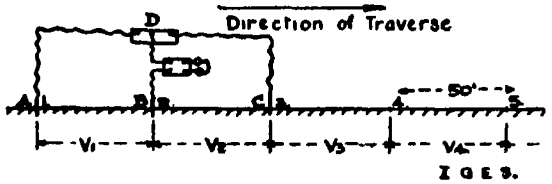

FIG 2 —Field procedure A C potential ratio method

The fact that this system becomes increasingly inaccurate as a buried conductor is approached is a sufficient indication that an additional surface potential method is required, by which the phase anomalies, which themselves are of diagnostic value, may be properly determined The A C potential ratio method described below is intended to fulfil this purpose

The principle of the method is shown in Fig 1, in which A, B, and C are contacts made with the ground and AO and CO are ratio arms in each of which a condenser and a resistance are connected Alternating current, usually at about 500 cycles per second, is passed through the ground between distant earthed electrodes The purpose of the device is to compare the potential drops V_1 and V_2 between the equidistant pairs of contacts AB and BC, and to determine the difference in phase angle between them To accomplish this, the capacity and resistance in each arm are adjusted until an exact balance is indicated by silence in the headphones The potential drops V_1 and V_2 will then be directly proportional to the total impedances † in the arms AO and OC respectively, or in terms of the resistances R_1 and R_2 and the capacitative reactances X_1 and X_2, which are read directly from the instrument

$$V_2 = \frac{R_2 \sin \tan^{-1} (R_1/X_1)}{R_1 \sin \tan^{-1} (R_2/X_2)} V_1$$

and $$\theta_2 - \theta_1 = \tan^{-1} R_2/X_2 - \tan^{-1} R_1/X_1,$$

where $\theta_2 - \theta_1$ is the difference in phase angle between V_2 and V_1, being of positive value when V_2 is leading V_1

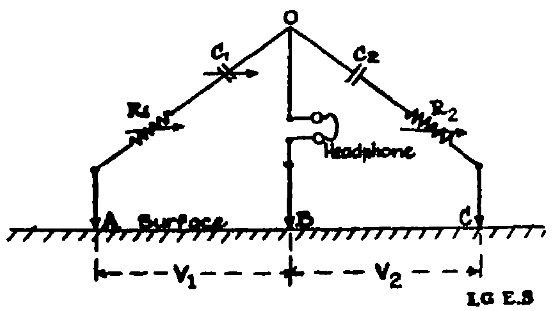

FIG 1 —Principle of A C potential ratio method

In Fig 1 the capacity and resistance in each arm are connected in series, but other combinations may be used As a result of a recent suggestion by D C Gall, an instrument is now being made in which a variable resistance alone is included in one arm of the bridge, the other arm containing a fixed resistance and variable condenser connected in parallel By this arrangement a larger phase angle range is available and the advantage of direct reading is obtained In the previous designs a somewhat tedious series of computations is necessary in order to obtain the potential ratios and differences in phase angle

As a rule, the field observations are made along

* Detailed descriptions of these methods and the apparatus employed will be included in the forthcoming publication of the Imperial Geophysical Experimental Survey, entitled "Principles and Practice of Geophysical Prospecting" This preliminary account is published with the approval of the Geophysical Executive Committee

† These should be of the order of 100,000 ohms Otherwise the accuracy of the determination may be seriously affected by the unknown contact resistances at A and C which enter into the measurement

straight lines, in the manner shown in Fig 2, the station interval depending upon the nature of the problem under investigation but usually being about 50 feet

The apparatus consists of three steel rods A, B, and

FIG 3—Ratiometer in use with amplifier on the operator's back

C, driven into the ground and connected to the ratiometer D, which is carried by the operator together with the headphones and amplifier as shown in Fig 3 Observations are made along the length of the traverse, the operator and his assistants moving forwards one station at a time, so that ratios are obtained for every successive pair of stations In the case shown in Fig 2, V_1 would be taken as an arbitrary unit and V_2, V_3, , etc, would then be referred to it by successive multiplication of the individual ratios $V_2/V_1, V_3/V_2$, , etc * A potential anomaly curve may then be constructed by plotting these multiplied ratios above the mid points of the station intervals to which they refer The differences in phase angle are summed consecutively, positive or negative as the case may be, and are plotted in a similar manner as a phase variation curve

It will have been observed that in order to obtain a balance with the bridge it is essential that the earth at contact B should be intermediate in potential with respect to the contacts at A and C It may happen, therefore, that even on a straight line traverse, points will be met with beyond which it is impossible to proceed in the ordinary way This difficulty may be overcome by side-stepping and including one or more stations off the line of the traverse, but with a bridge of a somewhat different design, now under construction, these deviations should no longer be necessary

In many cases it is sufficient to carry out a series of selected straight line traverses over the ground to be examined and to prepare potential and phase variation curves in the manner indicated above If a more systematic survey is required, observations must be made along a network of lines so that potential and phase values may be assigned to each station within the area These values are determined by vectorial addition and, after adjustment of closing errors, equipotential and iso phase lines may be interpolated

Field experience in Australia has shown that variations in ground conductivity are recorded very faithfully by this method In favourable circumstances the potential curves exhibit a well defined peak over each wall of a buried conductor, and with further research it is thought that the corresponding phase anomalies will be found to have a still greater diagnostic value In some districts in which marked variations occur in the surface conductivity, the method may be at a disadvantage unless the features to be investigated are of an outstanding character It is of particular service, however, as an auxiliary to the equipotential line method which, although of admitted value for reconnaissance purposes, is too crude for detailed investigations

For Comparison of Electromagnetic Fields

This application of the ratio arm bridge relates to the simultaneous comparison of magnetic fields at different points in the neighbourhood of conductive bodies, and the case of the vertical components at two points A and B is illustrated in Fig 4 The two identical coils C_1 and C_2, each having an area of several square feet, are supported in a horizontal position immediately above the points A and B and are connected together so that the e m f's induced in them will *assist one another* The ratiometer is then inserted into the circuit in the manner shown and is operated in precisely the same way as in the surface potential application of the instrument By this means the field intensities may be compared and the differences in phase angle determined Similar observations may be made for other positions of the coils and, in fact, the apparatus may be used in various ways for investigating the character of the ellipse at any point, provided that the differences in phase angle do not lie outside the range of the bridge It has been pointed out by D C Gall that in such cases a mutual inductance bridge would be more satisfactory and such an instrument is now under construction

As a rule, the field procedure and plotting of intensity and phase variation curves will be carried out

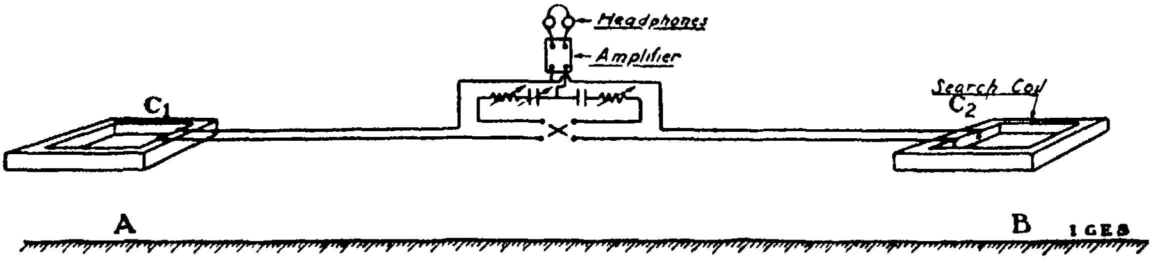

FIG 4—Comparison of magnetic fields with the ratiometer

* This multiplication is of complex numbers, that is, V_2/V_1 and V_3/V_2 are multiplied to obtain the magnitude of the product, and their phase angles are added to obtain the phase of the product.

in the manner already described for the surface potential method, but lines of equal magnetic intensity and iso phase lines may also be drawn

The method described above resembles the two-coil balancing system due to Sundberg and Lundberg, in which two similar coils are joined *in opposition*, with an amplifier and telephone included in the circuit In this case the relative strengths of the vertical fields are given by the secant of the angle through which one of the coils must be tilted out of the horizontal in order to produce a minimum of sound in the telephone It has been pointed out by Eve and Keys,* that this procedure is not always satisfactory owing to phase difference in the currents induced in the two coils, and the fact that the tilting of one of the coils will usually introduce a horizontal component into the determination These writers actually suggest a capacitance bridge in this connexion, but fear that such an instrument would prove too cumbersome for use under ordinary field conditions

* Applied Geophysics , p 122 (University Press, Cambridge, 1929)

Nomenclature at the Eleventh International Zoological Congress

THE account of the International Congress of Zoologists at Padua, published in NATURE for Sept 27, 1930 (pages 489 490), contained only the briefest reference to the discussions and conclusions on nomenclature The following account, which is strictly unofficial, may be of interest

The International Commission on Zoological Nomenclature consists of eighteen members, distributed so far as is practically convenient throughout the world Most of its work is conducted by correspondence, the intermediary being the secretary The present secretary is in Washington and is permitted by the U S Government to avail himself of official facilities

The commissioners meet in person at the International Congresses of Zoologists, which hitherto have been triennial, except for an interval from 1913 (Monaco) to 1927 (Budapest), but which by a resolution at Padua are henceforward to be quinquennial Hitherto each commissioner has been appointed for the triennial period , whether this will now be changed for a quinquennial period remains to be seen

Certain changes in the mode of appointment were accepted by the Padua Congress To replace the retiring commissioners, who are eligible for reappointment, the Commission, after considering the balance of subjects and of geographical regions, submits names to the Section of Nomenclature The Section can propose other names The nominees of both Commission and Section are referred to the Permanent Committee of the Congress, which makes the selection and reports it to the plenum of the Congress for confirmation

The commissioners assemble a week before the Congress opens, and work all day and every day at final discussion and voting on the questions raised during the interval These may be either opinions on points of nomenclature or proposals for alteration of the rules

Opinions are settled by a majority vote of the Commission, and this is generally obtained by correspondence

Proposed changes in the rules must also have received a preliminary majority vote of the whole Commission, that is, ten out of eighteen, and must then receive the unanimous vote of those present at the Congress, nine being a quorum It follows that, on one hand, eight commissioners may have opposed a proposal in writing, but that nine present in person may carry it , and on the other hand, that seventeen may have been in favour, but that one if present may block it These are extreme suppositions, but in actual practice the situation is no better, because of the difficulty of bringing all the members together, or even of obtaining a quorum of the actual commissioners To overcome this difficulty it has been the custom to appoint substitutes (alternates) for the absent commissioners from among zoologists attending the Congress Thus many of those who actually vote may have an imperfect understanding of the questions at issue. At Padua the preliminary work was done by the chairman (K Jordan), the secretary (C W Stiles), and three other commissioners , two more commissioners arrived later, but a quorum was not formed until alternates were appointed Of these there were no less than eleven, and among them Lt Col J Stephenson, Mr G C Robson, and Mr H W Parker acted for commissioners in various parts of the British Empire

On this occasion a further difficulty was due to the fact that before the meeting none of the proposals for change in the rules had received enough votes either to kill it or to bring it up for discussion Until the Congress assembled it was impossible to get the necessary votes, and then, even if they were obtained, it was too late for adequate and properly informed discussion

This state of affairs is manifestly undesirable, and for many years considerable dissatisfaction with these arrangements has been expressed, notably with the demand for a unanimous vote by those present There were two alternative amendments to this by law before the Commission, but unfortunately neither received enough preliminary votes to enable it to be discussed

The same was the fate of other important proposals Among them were alternative motions which would have had the effect of raising type designation by elimination from the status of a recommendation to the status of a rule This is a difficult question, and it is a pity that it could not be thrashed out

A proposal to revert to the XII Edition of Linnæus' Systema Naturæ" as the starting point of zoological nomenclature was definitely rejected, and the date of the X Edition was fixed precisely as Jan 1, 1758, in Article 26 of the rules

The definition of publication for purposes of systematic zoology was discussed at length, and the conclusions will eventually be submitted in the form of an opinion

The report of the British National Committee on Entomological Nomenclature was presented by Dr K Jordan, and its proposed emendations to the rules were considered A few, of merely editorial nature, were provisionally adopted and others deferred for further consideration

Proposals that superfamily names based on generic names should all end in *-oidea*, that new ordinal names should end in *ida*, and subordinal names in *ina* were discussed and held for further consideration

Proposals to apply the law of priority to family and subfamily names, under certain conditions necessitated by other provisions of the Code, were also inevitably held over The general opinion of the Commission seemed to be against further legislation for groups higher than genera

As regards homonyms, it was agreed that, *ceteris*

paribus, the name of a genus should take precedence over that of a subgenus, the name of a species over that of a subspecies

Article 19 of the rules says that "the original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident" It was agreed that the word "transcription" included, or rather was intended to mean, "transliteration" This article has sometimes important results in connexion with homonyms Concerning such trivialities as whether one should write *brownii* or *browni*, the Commission showed a wise impatience It also agreed that when a name, or part of a name in combination, had been spelled in diverse ways by different authors or even by the same author, it was not incumbent on a subsequent author, when making casual references, to follow this diversity of spelling It was enough that he should do so in professed synonymic lists

During the interval between the tenth and eleventh Congresses the Commission had formulated twenty six opinions (Nos 98 123), and these were adopted by the Congress These opinions have been or are being published by the Smithsonian Institution

The Commission would welcome the co operation of special committees for groups of animals Such co-operation already exists for entomology and proves of great advantage

The Commission believes that much confusion would be avoided if students of zoology had the opportunity—if not the obligation—to attend lectures on the rules of nomenclature

I have kept to the last the most controversial of the subjects that came up at Padua This is the interpretation of Article 25b of the Code It is there laid down that "The valid name of a genus or species can be only that name under which it was first designated on the condition (b) That the author has applied the principles of binary nomenclature" Article 26 says "The tenth Edition of Linné's 'Systema Naturæ', 1758, is the work which inaugurated the consistent general application of the binary nomenclature in zoology"

The question in dispute is the meaning of the phrase "binary nomenclature" One interpretation is that it means that form of zoological nomenclature which most zoologists associate with Linnæus and notably with the tenth edition of his "Systema", namely, one name for the genus, with which is associated another, so-called trivial name, to make up the *nomen specificum* The addition of a third name to distinguish a subspecies, or even of a fourth for a variety, does not affect the principle that the species is designated by a double or binary name The essence of the Linnean reform, as first fully expressed in the Tenth Edition, is the introduction of a *nomen triviale* in place of the former *differentia*, the *nomen triviale* being a pure name, not necessarily with any meaning, whereas the *differentia* was a descriptive diagnostic phrase, however short it might be

The other interpretation of "binary nomenclature" reduces it to mean no more than 'binary classification', in other words, the recognition of the two concepts *genus* and *species*, and their nomenclature, according to the old logical method, *per genus et differentiam*

The introduction of this latter method into systematic biology is ascribed to the botanist Tournefort (1719) The method was at first followed by Linnæus as by many others, but he perceived its nomenclatural cumbrousness (as indeed had Tournefort himself) and got over the difficulty by using the *nomen triviale* in place of the *differentia* This he essayed before 1758, but it was in that year, in the Tenth Edition, that he first applied it consistently to the whole animal kingdom

Taking the rules as they stand, any unsophisticated zoologist would, I think, adopt the former interpretation In the successive reports of the Congress and successive editions of the rules I have been unable to find anything that suggests the contrary, with the exception of four opinions (20, 24, 35, 89) These draw a distinction between the terms 'binary' and 'binominal' (undoubtedly they do not mean the same thing) and proceed to imply that 'binary' indicates nomenclature *à la Tournefort*, while only 'binominal' indicates nomenclature *à la Linné*

The history of this interpretation of the phrase 'binary nomenclature' has been given by Dr L Stejneger in a most careful paper (*Smithson Miscell Coll*, vol 77, No 1, August 1924), which leaves no doubt that the revisers of the Code in 1901 really did give the phrase what one may call the Tournefort sense, and that their reason for that interpretation was the desire to include the generic names of Brisson, L T Gronovius, Scopoli, and other writers after 1758 who did not follow the nomenclatural system of Linnæus, and to include them without making exceptions to the rules

That this was their intention was, as Dr Stejneger himself admits, far from obvious, and it certainly has never been clear to a large number of zoologists However that may be, there has been an increasing movement to give the phrase the same meaning as the tautological expression "binominal nomenclature" A proposal to that effect was before the Commission at Padua, but failed to receive enough preliminary votes to bring it up for discussion In the Section of Nomenclature, Dr Walther Horn then proposed the following motion "The Congress shall decide that only those publications shall be held to apply the principles of binary nomenclature in which the use of a single word for a generic name and a single word for a species name is consistently carried out" This was passed by a large majority in the Section, and when it came before the plenary session of the Congress, instead of being referred, as one expected, to the Commission, it was put to the meeting without discussion, and again carried by a large majority

It happens, most unfortunately, that those who support what I have called the Tournefort interpretation are for the most part citizens of the United States and include the distinguished and enthusiastic secretary of the Commission, whereas most of those who support the Linnean interpretation come from the rest of the world and in great part from Europe I do not, however, see any reason why this divergence of opinion cannot be accommodated The resolution does not, in my opinion, involve any alteration of the rules, it is a question of interpretation It does involve a redrafting of certain opinions, but it need not involve any change in their effect or in the acceptance of Brisson and the rest

It should be remembered that in 1901 it was not possible to suspend the rules to meet hard cases That practical reform was first achieved at Monaco in 1913 Therefore in 1901 the upholders of Brisson, Scopoli, and Co were obliged either to alter the rules or to interpret them so as to admit those authors They inadvisedly adopted the latter course and failed to make it clear

Their interpretation has been used, as stated above, to admit the uninominal generic names of certain writers after 1758 who did not follow the Linnean method But those writers did occasionally chance to use a specific *differentia* of a single word, and, on this interpretation, there seems nothing to prevent the admission of those appellations That, however, does not seem desired by anyone

Now we can suspend the rules, and we have already

found it necessary to do so in order to eliminate certain authors who, under the Tournefort interpretation, were admissible (opinion 89).

My proposal therefore is that we should, as the Congress has resolved, adopt the Linnean interpretation, which I personally believe to be the natural meaning of the words; that we should formulate a new opinion admitting the generic names of Brisson and the rest by *ad hoc* suspension of Article 25b; and that we should redraft those opinions that are affected (20 and 24). As for opinion 89, I succeeded at the time in getting it so drafted that its effect would not be altered by the change of interpretation now passed by the Congress.

If these proposals are approved by the International Commission, I do not see why we should not continue to work with that harmony and good feeling which have hitherto prevailed at our meetings.

F. A. BATHER.

University and Educational Intelligence

CAMBRIDGE.—Prof. Owen Thomas Jones, Woodwardian professor of geology, has been elected to a professorial fellowship at Clare College.

At Trinity College, A. S. Besicovitch, University lecturer in mathematics, and L. Wittgenstein have been elected to fellowships.

The Appointments Committee of the Faculty of Geography has reappointed Miss M. S. Willis, of Newnham College, to be University demonstrator in the Faculty.

The Council of the Senate recommends the acceptance of the offer of the Council of the Royal Society to provide within three years a sum of £15,000 towards the building and equipment of a Laboratory for special physical investigations in the University of Cambridge, to be used in the first instance for magnetic and cryogenic research.

LONDON.—The title of emeritus professor has been conferred on Dr. Alice Werner, formerly University professor of Swahili and the Bantu languages at the School of Oriental Studies.

On the recommendation of the Board of Management of the London School of Hygiene and Tropical Medicine, Sir George Newman has been appointed Heath Clark Lecturer for the year 1931.

OXFORD.—Prof. A. Einstein will deliver the Rhodes Memorial Lecture for the year 1930–31; he will be in residence in Oxford during the next summer term.

ST. ANDREWS.—On the recommendation of the Senatus Academicus, the Court on Dec. 19 unanimously agreed to appoint Dr. David Lennox to be reader in forensic medicine, and Dr. W. L. Burgess to be reader in public health, in recognition of their long and distinguished service to the University as lecturers in these subjects.

Mr. George H. S. Milln was appointed lecturer in radiology and electrical therapeutics in the University, and Dr. David Jack to be a lecturer in natural philosophy in the United College, St. Andrews.

The Senatus Academicus has appointed Dr. R. R. Marett, Rector of Exeter College, Oxford, as Gifford Lecturer for 1931–32.

It was reported that the last Examination for the diploma and title of L.L.A. will be held in May next. The only candidates to be received are those who have already obtained part of the qualification and desire to complete it.

Birthdays and Research Centres.

Jan. 1, 1869.—Prof. A. A. T. BRACHET, For. Mem. R.S., Rector of the University of Brussels and director of the Laboratory of Embryology of the Faculty of Medicine in the University.

Le laboratoire d'Embryologie de la Faculté de médecine de Bruxelles suit principalement deux lignes de recherches. D'une part, l'analyse des localisations germinales et du déterminisme de la morphogénèse chez les Vertébrés, spécialement les Amphibiens; d'autre part, l'étude de la physiologie de la mise en marche du développement et des cinèses de segmentation.

Jan. 7, 1885.—Prof. A. J. ALLMAND, F.R.S., professor of chemistry, King's College, London.

The chemical laboratory at King's College is a comparatively small one, and the conditions, therefore, unfavourable for directed team work research towards pre-specified major objectives. But I believe firmly that almost any subject, if worked on pertinaciously and with reasonable skill, conscientiously (that is, with self-criticism), and with the desire for early publication strictly suppressed, may yield at any time results of real interest, even of importance. On this account, I would hesitate to say which I consider the chief investigation now in progress in this laboratory.

My students are working (1) at photochemistry, particularly at present on the effect of wave-length on the union of hydrogen and chlorine, as also on other reactions; (2) on the problem of the complete evaluation of the partial molal free energies in systems of the type lead chloride–alkali metal chloride–water; (3) on the sorption of vapours and gases by charcoal and other solid sorbents.

These investigations have all been in progress for years and have all proved sufficiently fruitful to satisfy us.

Jan. 8, 1856.—Prof. H. LECOMTE, professor of botany in the Paris Museum of Natural History.

Since his appointment to the professorship of botany in the Paris Museum, Prof. Lecomte has directed the work of the staff definitely to the study of Colonial floras, which were known before only in a fragmentary way. The "Flore Générale de l'Indo-Chine" was the first undertaken (1906); forty-four parts, out of about fifty it will comprise, have been already completed, with the devoted assistance of the scientific staff, of many Parisian botanists frequenting the Laboratory, and of professors from Paris and provincial universities. Besides, a great quantity of working material has been assembled and is ready to study for the preparation of floras of other French colonies: Guiana, Antilles, tropical Africa, Madagascar, New Caledonia. For some years past, and to complete this work, Prof. Lecomte has undertaken the anatomical study of tropical woods, of great interest from the point of view of the affinities it reveals, and also for the applications it enables one to foresee. Two important books have been published on woods of Indo-China and Madagascar.

Jan. 8, 1868.—Sir FRANK W. DYSON, K.B.E., F.R.S., Astronomer Royal.

A problem to which attention might usefully be given is the determination of the radial velocities of distant stars, such as those of early B type and those with the *c* characteristic in the southern half of the Galaxy. Dr. Oort has shown that the rotation of the system of stars round a point in galactic longitude l_0 would give rise to a term $Ar \sin 2(l-l_0)$ in their radial

velocities where r denotes the distance and A is a constant Prof Plaskett from observations of 250 stars finds $A = 17$ km per sec for a distance of 1000 parsecs and $l_0 = 325°$, but he could only observe four stars between the longitudes 193° and 343°, and until this lacuna has been filled up by observations in the southern hemisphere, this important result must be regarded as insufficiently verified

Societies and Academies

LONDON

Optical Society, Dec 11 —**T H Court** and **Moritz von Rohr** New knowledge on old telescopes The paper is mainly historical —**Mrs E Clifford** On interpolating refractive indices Some useful formulæ are obtained —**H Buckley** *On the determination of the transmission factors of coloured step lenses* In the 1928 report of the International Commission on Illuminations Committee on Coloured Glass for Signal Purposes, an outline of a method of measuring the transmission factors of coloured lenses used in railway signals is given The deduction from the *assumptions made in this report is incorrect*

CAMBRIDGE

Philosophical Society, Dec 8 - **C G Darwin** The diamagnetism of the free electron Landau's work *on the diamagnetism of free electrons is illustrated by* representing the boundary wall by a special law of force, for which the wave equation admits of exact solution —**P A M Dirac** Note on the interpretation of the density matrix in the many electron problem The probability of two or more electrons being simultaneously in specified places is evaluated in terms of the density matrix It is found to be just the determinant of those matrix elements that lie in the rows and columns referring to the specified places —**L H Gray** The photoelectric absorption of gamma rays Direct experimental evidence shows conclusively that the λ^3 law characteristic of the photoelectric absorption of X rays is not valid for γ rays Not only is the absorption of hard γ radiation very much greater than would be anticipated, but also the variation of the absorption coefficient with atomic number as well as with wave length appears to be anomalous in the neighbourhood of 5 X U and suggests the existence of a new absorbing mechanism An empirical photoelectric law is suggested —**L G Vedy** On the rotation of dielectrics in electrostatic fields and related phenomena The rotation of a dielectric covered body, suspended between the poles of a Wimshurst machine, is due to the accumulation of charge on the surface of the body, under the action of the brush discharge, and to the subsequent electrostatic repulsion of the locally charged surface The effect of the rate of decay of the surface charge on the rate of rotation is investigated theoretically

PARIS

Academy of Sciences, Nov 24 —**P Viala** and **P Marsais** The Mycoliths of the vine in Palestine The name Mycolith is given by the authors to masses produced by an agglomeration of very fine sand cemented together by the mycelium of a new species of Ascomycete, *Lithomyces nidulans* These formations are called the vine fungus by cultivators in Palestine and the vine is ultimately destroyed by them —**Serge Bernstein** A method of summation of trigonometrical series —Edmond Sergent was elected *Correspondant* for the Section of Rural Economy in succession to the late M Trabut.—**J Herbrand** Determination of the ramification groups of a body starting from those of a super body —**Paul Lévy** The law of large numbers —**Gr C Moisil** The equation $\Delta u = 0$ —**Gaston Julia** The convergence of series of rational repeated fractions —**Jacques Chokhate** An extended class of continued algebraical fractions and the corresponding Tchebycheff polynomials —**N Achieser** The asymptotic value of the best approximation of some values by polynomials —**Mandelbrojt** Some *theorems generalising the Riemann relation between* $\zeta(s)$ and $\zeta(1-s)$ —**G Fayet** The favourable oppositions of the planet Eros There will be a very favourable position in February 1931, and a fairly good one in November 1937 —**N Stokyo** The determination of the orbits of distant stars —**Edgar Pierre Tawil** A method of observation of non stationary sound waves —**V Posejpal** The direct determination of the volume of the electron —**Mlle Jacqueline Zadoc-Kahn** The thermal variation of the magnetic double refraction of para azoxyanisol above the temperature of the disappearance of the mesomorphic state Experiments carried out with the large Bellevue magnet, with special precautions to secure uniformity of temperature The relation found between the double refraction and the temperature is shown on a curve The theory suggested by Cotton and developed by Kast, *representing mesomorphic liquids as constituted* by associations of molecules, is consistent with the curve shown —**S Rosenblum** A new magnetic spectrograph with α rays The first experiments with the apparatus described showed photographically the fine structure in the case of thorium for the two lines α and α^1, the velocities of which differ by only 3/1000 The intensity of the field was relatively small, about 16,000 gauss —**C Raveau** The utilisation of streams at the mouth Correction —**F Pingault** The conditions of formation and decomposition of cementite At temperatures below 1000° C pure cementite appears to be very stable, but at temperatures approaching fusion the cementite decomposes very rapidly, giving graphite —**Augustin Boutaric** and **Maurice Doladilhe** The modifications produced in the absorption spectrum curve of a solution of a colouring matter by the introduction of a colloid into the solution A simple method is developed for determining whether a colouring matter is colloidal or not Two hydrosols are taken the granules of which are of contrary sign, such as arsenic sulphide and ferric hydroxide, and some drops of the colour solution are introduced If no diminution of colour is produced—and for this a simple colorimeter is usually sufficient—the colouring matter is molecular If the colour is colloidal a clear diminution of opacity can be seen, often without the use of an instrument, after introducing the colloid, the granules possess the opposite sign to that of the colouring matter —**Raymond Delaby** and **Raymond Charonnat** The pyrolysis of vegetable oils with high acetyl index From the analysis of the products of the dry distillation of grape pip oil it is concluded that the latter does not contain ricinoleic acid —**Joseph Robin** The 1 3 migration of amino groups The mechanism Application to other analogous reactions —**Octave Mengel** The lower limit of the Quaternary in the eastern Pyrenees —**Maurice Blumenthal** The relations of the subbetic and penibetic zones at the level of Archidona Alfarnate (Malaga and Grenada) —**J Thoulet** Liquid submarine volcanic columns —**Adrien Davy de Virville** The zone distribution of *Rivularis bullata* - **C N Dawydoff** The Semper larvæ of Indo Chinese waters —**R Fosse, A Brunel, P de Graeve, P E Thomas**, and **J Sarazin** The destruction in the seed of *Soya hispida* of one of its ferments without suppressing the activity of two others A method of suppressing uricase in soja bean without destroying the activity of allantoinase or urease —**E Brumpt** Intense parasitic relapses due to splenectomy, in the course of latent infections of

Egyptianella in the fowl —**S Jellinek** The biological effects of short wave oscillating fields on living beings The effects of d'Arsonvalisation have been attributed to the thermal effects of the high frequency, but the author does not agree with this and gives experimental evidence in support of his views

COPENHAGEN

Royal Danish Academy of Science and Letters, Oct 17 —**Niels Bohr** The use of the concepts of space and time in atomic theory The recent development of atomic theory has disclosed a principal limitation of our ideas of motion In this connexion a closer analysis of the foundation of space time measurements of atomic particles is attempted

GENEVA

Society of Physics and Natural History, Nov 6 —**R Wavre** Equilibrium figures and the planet Jupiter The author applies his method of research for equilibrium figures to the case of Jupiter He shows that on account of the great flattening of this planet it is necessary to take into account terms of order of the sixth power of the angular velocity, to agree with the data of Sampson relating to the planet and its satellites His study also tends to show that Jupiter and Saturn, although more 'condensed' than the earth, are less so than is believed, and that from this point of view the comparison with the earth can be sustained It is not necessary to assume the existence of a very dense nucleus, surrounded by a homogeneous fluid —**P Rossier** and **G Tierey** The statistical distribution of the stars as a function of spectral type The authors give the results of a discussion based on two hundred negatives obtained in 1928 and 1929, with the Schaer Boulenger prism objective of the Geneva Observatory The normal exposure chosen was 20 minutes made on 'Cappel blu' plates The control stars are all of the *A*0 type —**S Ansbacher** A case of poisoning by potassium chlorate The author describes a case of poisoning by potassium chlorate in which the amount of this salt in the urine reached 2 6 per cent

SYDNEY

Linnean Society of New South Wales, Oct 29 —**R H Anderson** Notes on the Australian species of the genus *Atriplex* Four species are described as new, and several new forms and varieties of established species are also defined —**H Claire Weekes** On placentation in reptiles (2) Allantoplacentation is described in various lizards A series showing increasing specialisation can be made out —**T Thomson Flynn** The uterine cycle of pregnancy and pseudo pregnancy as it is in the diprotodont marsupial *Bettongia cuniculus* *Bettongia* is polyœstrous, breeding over the greater part of the year Ovulation is spontaneous and unilateral Pregnancy is alternate on each side, the contralateral uterus entering into a state of pseudo pregnancy The lactatory period of one pregnancy overlaps the gestatory period of the next succeeding one The pregnant and pseudo pregnant uteri until mid pregnancy undergo identical changes —**W F Blakely** and **Rev E N McKie** Additions to the flora of New England This paper deals with six new species and two new varieties of plants from the New England Tableland, as follows one species of *Grevillea,* one species and one variety of *Aotus,* one variety of *Brachyloma,* and three species of *Eucalyptus* —**W F Blakely** A new species of *Eucalyptus* from New England A species of *Eucalyptus,* nearest to *E conglomerata,* is described from Moredun Creek and other localities

Official Publications Received.

BRITISH

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series Vol 15 The Fossil Fauna of the Samana Range and some neighbouring Areas Part 1 An Introductory Note By Lieut.-Col L M Davies Pp v+15+4 plates 1 4 rupees, 2s Part 2 The Albian Echinoidea. By Dr Ethel D Currie Pp. v+17 28+plate 4s. 12 annas, 1s 3d Part 3 The Brachiopoda By Helen Marguerite Muir Wood Pp. v+25 37+plates 5 6. 1 4 rupees 2s. Part 4 Lower Albian Gastropoda and Lamellibranchia. By L R. Cox Pp v+39-49+plate 7 14 annas 1s 6d Part 5 The Lower Cretaceous Ammonoidea, with Notes on Albian Cephalopoda from Hazara. By Dr L F Spath Pp v+51 66+plates 8 9 1 6 rupees 2s 3d. Part 6 The Palaeocene Foraminifera By Lieut Col L M Davies Pp v+67 79+plate 10 14 annas 1s 6d Part 7 The Lower Eocene Corals By Dr J W Gregory Pp v+81 128+plates 11 16 3 14 rupees 6s 6d Part 8 The Mollusca of the Hangu Shales By L R. Cox Pp v+129 222+plates 17 22 4 14 rupees, 8s (Calcutta Government of India Central Publication Branch)

Department of Agriculture Jamaica. Entomological Bulletin No 5 Insect Pests of Sweet Potato and of Cassawa in Jamaica. By W H Edwards Pp ii+12+1 plate (Kingston B W I Government Printing Office)

FOREIGN

Spisy vydavane Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l Université Masaryk) Čis 123 Příspěvek ke studiu tvorby solí glykokolu (Contribution à l étude de la Faculté de la glykokolle de former des sels) Napsali J V Dubsky a A Rabas Pp 18 Čis 124 Contribution to the Study of Blood Groups in Czechoslovakia By Prof V Suk Pp 15 Čis 125 *Faultless Teeth and Blood Groups (with Remarks on Decay and Care of Teeth in Whites).* By Prof V Suk Pp 11 Čis 126 K problému buzení netlumených elektromagnetických vln (Sur le problème de l excitation des ondes électromagnétiques non amorties) Napsal J Sahánek Pp 24 Čis 127 Odraz světla na kovech (Réflexion metallique). Napsal Josef Zahradníček Pp 16 (Brno A Píša.)

Spisy Lékařské Fakulty Masarykovy University (Publications de la Faculté de Médecine) Brno Svazek (Tome) 8 Spis (Fascicule) 70 85 Pp 276 (Brno A Píša) 40 kč

CATALOGUES ETC

The Nickel Bulletin Vol 3 No 12 December Pp 377 408 (London The Mond Nickel Co Ltd)

Diary for 1931 (Bonnybridge John G Stein and Co Ltd)

Diary of Societies

FRIDAY JANUARY 2

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —S J Davies An Experimental Investigation into Induction Conditions Distribution and Turbulence in Petrol Engines

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —W A Benton Weighing Machinery

SATURDAY, JANUARY 3

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —*Prof A M Tyndall* The Electric Spark (3) Air as a Conductor of Electricity (Juvenile Lectures)

MONDAY, JANUARY 5

ROYAL GEOGRAPHICAL SOCIETY, at 3 30 —Dr T F Chipp What we get from the Tropics (Christmas Lecture for Young People).

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4 30 —Lieut Col A G Shortt The Fifteenth Year of Tiberius

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Section) (at University Liverpool) at 7 —D B Hoseason The Cooling of Electrical Machines

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —T A D Braddell Criticism of Work submitted for Prizes and Studentships.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —*Prof R. Robinson The Synthesis of Certain Anthocyanins*

TUESDAY JANUARY 6

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Prof A M Tyndall The Electric Spark (4) The Mechanism of a Spark and other Forms of Discharge (Juvenile Lectures)

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester) at 7

INSTITUTE OF METALS (*Birmingham Section*) (at Chamber of Commerce, Birmingham) at 7 —R A Hacking Blast Furnace Reactions

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Meeting) at 7 —Projection of Films —O Blakeston Light Rhythms —S G French The Man who was Late

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 45 —F G Woollard Automobile Plant Depreciation and Replacement Problems

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section) at 8 —Col S L Brug Filariasis in the Dutch East Indies

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —J W Layard Malekula

WEDNESDAY, JANUARY 7

ROYAL SOCIETY OF ARTS, at 8 —H Barnard Ancient and Modern Pottery (Dr Mann Juvenile Lectures) (1)

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—F. M. Colebrook and R. M. Wilmotte: A New Method of Measurement of Resistance and Reactance at Radio Frequencies.—E. B. Moullin: A Variable Capacity Cylindrical Condenser for Precision Measurements.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—C. G. H. Hallett: Notes on the Theory of Radiant Heating.

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—Modern Metal Cleaning.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Pathological Evening.

THURSDAY, JANUARY 8.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Northern Irish District) *(at Town Hall Bangor), at 3.—G. H. Fleming: Urban Works.*

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (5): Some Properties of Sparks and Arcs (Juvenile Lectures).

LINNEAN SOCIETY OF LONDON, at 5.—Prof. E. J. Salisbury: A Study of *Ranunculus parviflorus* L. with Special Reference to its Morphology and Ecology.—H. W. Pugsley and A. J. Wilmott: New British Plants.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—C. E. R. Bruce: The Distribution of Energy liberated in an Oil Circuit Breaker with a Contribution to the Study of the Arc Temperature.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—A. Gouge: Some Aspects of the Design and Construction of Sea going Aircraft.

INSTITUTION OF ELECTRICAL ENGINEERS (at Loughborough College), at 6.45.—E. G. Clark and G. Fowler: The Consumer's Point of View.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers Technical College, Bristol), at 7.—E. V. Pannell: Light Alloy Piston Development.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.—Discussion on Faults and Failures in Colour Photography.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at University, Bristol), at 7.30.—E. A. Ashcroft: Electrolysis of Fused Zinc Chloride.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees side Branch Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—J. R. Cone: Ironwork Practice.

INSTITUTE OF METALS (London Section) (at 88 Pall Mall), at 7.30.—R. Genders: Extrusion.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 30 Russell Square), at 7.30.—Dr. T. H. Durrans: Solvents.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.30.—*H. D. Lloyd and J. S. G. Primrose*: The Use of Pure Iron Electrodes for Welding Cast Iron.

FRIDAY, JANUARY 9.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—Dr. C. M. Yonge: Life on the Great Barrier Reef (Christmas Lecture for Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—A. Dean and M. M. Macmaster: Mercury Arc Rectifiers.

OIL AND COLOUR CHEMISTS' ASSOCIATION (jointly with Society of Chemical Industry, *Literary and Philosophical Society* and *Society of Dyers and Colourists*) (in Psychology Department, University, Manchester), at 7.—W. O. D. Pierce: Human Factors in Colour Judgment.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Doonan: Monel Metal: Some Notes on its Production and Industrial Application.

GEOLOGISTS' *ASSOCIATION* (in Botany Theatre, University College), at 7.30.—Special General Meeting.

SATURDAY, JANUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (6): Large Sparks (Juvenile Lectures).

PUBLIC LECTURES.

TUESDAY, JANUARY 6.

UNIVERSITY OF LEEDS, at 6.—Prof. W. Garstang: Life in the Sea.

WEDNESDAY, JANUARY 7.

MUSEUM AND ART GALLERY, BELFAST, at 8.—F. Rutter: Modern British Art.

CONFERENCES.

DECEMBER 31 TO JANUARY 5.

GEOGRAPHICAL ASSOCIATION.

Friday, Jan. 2 (at London School of Economics).

At 10 A.M.—Major R. W. G. Hingston: In the Tree Roof of the Guiana Forest (Lecture).

At 11.30 A.M.—*Miss R. M. Fleming: Regions of Russia* (Lecture).

At 2.30.—Meeting for Teachers in Secondary Schools for Discussion on a paper by B. C. Wallis on School Geography from the Point of View of an Examiner.

Meeting for Teachers in Primary Schools.—Geography and the Extension of the School Age. *Discussion to be opened by E. J. Orford.*

Saturday, Jan. 3 (at London School of Economics).

At 10.15 A.M.—Dr. P. W. Bryan: The Distribution of Houses in England and Wales as a Population Index (Lecture).

DECEMBER 31 TO JANUARY 7.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

DALTON ASSOCIATION.

Friday, Jan. 2, at 11.—G. W. Spriggs: Individual Work in Mathematic (Lecture).

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION.

At 2.—Dr. A. G. Maitland Jones and others: Discussion on Hour of Sleep and the School Child in Day and Public Schools.

CHILD-STUDY SOCIETY.

At 5.30.—Prof. J. E. Marcault: What is Religious in the Child (Lecture).

MODERN LANGUAGE ASSOCIATION.

Monday, Jan. 5, at 11 A.M.—Prof. E. W. Scripture and Prof. P. Menzerath: Discussion on Experimental Phonetics.

NATIONAL COLLEGE OF TEACHERS OF THE DEAF.

At 11 A.M.—Dr. J. Drever: The Educational Handicap of the Dea *from a Psychologist's Point of View (Lecture).*

JOINT CONFERENCE.

At 5.—J. Fairgrieve, Lt.-Gen. Sir William Furse, Miss B. Hosgood, C. B. Thurston: The Teaching of Geography. Chairman: Sir Richar Gregory.

CENTRAL COUNCIL FOR SCHOOL BROADCASTING.

Tuesday, Jan. 6, at 11 A.M.—Prof. Winifred Cullis and others: Th Teaching of Biology by Wireless (Lecture Demonstration).

BRITISH SOCIAL HYGIENE COUNCIL.

At 5.—Dr. H. Crichton Miller: Marriage, Freedom, and Educatio (Lecture).

JANUARY 5 AND 6.

MATHEMATICAL ASSOCIATION (at London Day Training College).

Monday, Jan. 5, at 3.30.—Sir Arthur S. Eddington: The End of th World (from the standpoint of Mathematical Physics) (Presidentia Address).

At 5.—Prof. A. R. Forsyth: Dimensions in Geometry.

Tuesday, Jan. 6, at 10 A.M.—A. Robson and others: Discussion on Th Report on the Teaching of Mechanics in Schools.

At 11.30 A.M.—W. Hope-Jones, Dr. F. J. W. Whipple, P. M. Marples and others: Discussion on Gambling.

At 2.30.—Prof. J. E. A. Steggall: Faith and Reason in beginning th Calculus and Elsewhere.

At 3.45.—Prof. E. H. Neville: Limits in Geometry.

JANUARY 6 TO 9.

SCIENCE MASTERS' ASSOCIATION (at University, Birmingham).

Tuesday, Jan. 6, at 8.30 P.M.—Sir Charles Grant Robertson: Presidentia *Address.*

Wednesday, Jan. 7, at 10.15 A.M.—J. Young: The Lunar Landscap (Lecture).

At 11.30 A.M.—Prof. W. N. Haworth: An Insight into Comple Molecular Structures (Lecture).

At 6.—*Prof. Nash: The Work of the Physicist and Chemist in th* Petroleum Industry (Lecture).

At 8.15.—The Lord Bishop of Birmingham: A Finite Universe (Lecture).

Thursday, Jan. 8, 10 to 11.15 A.M.—F. Fairbrother and others: Discus sion on General Science.

At 12.—Prof. K. N. Moss: Scholarships offered in Coal Mining an Metal Mining.

6 to 7.15.—Prof. F. W. Burstall: The Science Education of the Bo up to Eighteen Years of Age (Lecture).

At 8.30.—Meeting of S.M.A. with Representatives of the Commis sion on Educational and Cultural Films.

Friday, Jan. 9, at 10 A.M.—Prof. H. Munro Fox: Zoological Experi ments for School Work.

EXHIBITION.

JANUARY 6 TO 8.

PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION OF ELECTRICAL, OPTICAL, AND OTHER PHYSICAL APPARATUS (at Imperial College of Science an Technology), at 3 to 6, and 7 to 10.

Wednesday, Jan. 7, at 8 P.M.—E. Lancaster Jones: Searching fo Minerals with Scientific Instruments (Lecture).

Thursday, Jan. 8, at 8 P.M.—Sir Gilbert Walker: Physics of Spor (Lecture).

Editorial and Publishing Offices

MACMILLAN & CO., LTD.

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SATURDAY, JANUARY 10, 1931.

CONTENTS.

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The Protection of Scientific Property.

THE debate on the protection of scientific property at the last session of the Sub-Committee on Intellectual Rights of the International Committee on Intellectual Co-operation gained special interest from the presence of two members of the Italian National Committee, who submitted a memorandum suggesting substantial amendments to the preliminary draft Convention of Dec 14, 1927 This draft Convention, which was presented to the Assembly of the League of Nations in September 1928, proposed to create by means of an International Convention and a corresponding Union a new right, leaving the existing structure of patent law and copyright untouched The Convention is designed to secure for the authors of scientific discoveries participation in the material profits arising from their industrial exploitation

Scientific discoveries which entitle their authors to receive remuneration from the users of the discovery must fulfil two conditions

(1) They must be open to material utilisation, in the sense that they contribute to the production of a commercial commodity , and

(2) They must lead to new means of production or new applications of existing means of production Discoveries which are explanations of existing practice and purely retrospective in their application are thus definitely excluded, although of course they may strengthen industrial practice and increase its confidence

In the second part of the Convention, the rights and obligations of the authors are defined, and in doing so, a distinction is made between the creation or recognition and the exercise of the right While the rights of the author are derived from the unequivocal publication of the discovery, the exercise of these rights as against the users of the discovery is declared to be effective only as from the date of the registration, by an international organisation, of the deposit of a note claiming for the author the right defined in Article 1 over material applications of the discovery Thus, in a dispute between two authors, priority may be established by the production of *any* document of unquestioned date, but in a dispute between author and users, the *only* lawful proof which can be adduced against the users is a note registered with an international organisation and accompanied by specified claims with reference to the practical application of the discovery a result which would probably be achieved by the creation of a new bureau on the lines of the Berne Bureaux of Industrial, Literary,

and *Artistic Property* *The restriction of the exercise of the right to this condition on international* registration under specific conditions of publicity meets a perfectly legitimate stipulation on the part of manufacturers if they are to incur liability or obligations

Part III of the Convention defines the rights and obligations of the user, and distinguishes clearly between the new right and patents The new right confers no monopoly of exploitation, any undertaking may use the discovery, subject only to payment to the authors of a consideration, the nature of which is to be fixed either by free agreement between the authors and users, or failing such agreement, by judicial procedure It is, of course, quite possible that a dispute may arise between men of science as to priority when the discovery is already receiving industrial exploitation Article 12 of this section accordingly endeavours to secure that the industrial exploitation shall go on unhindered while the dispute is fought out, and a concluding article, inserted to ensure that the terms of contracts shall not destroy the legitimate expectations which the Convention arouses in the minds of discoverers, asserts that all private agreements which are contrary to the provisions of the Convention shall be deemed null and void, as being prejudicial to the public order

On behalf of the Italian Committee, M Piola Caselli and Prof G Bruni (professor of general and inorganic chemistry at the Royal Engineering School at Milan) suggested the addition to Article 4 of a stipulation that the note claiming the right must be deposited within three years from the date of publication from which the right is derived, and further that the right should be limited to the duration of the inventor's patent instead of to the term of thirty years contemplated in Article 10 Further recommendations were made that the remuneration should be determined by the courts of the user's country, rather than by an international court of arbitration, and provision made for cases of joint discovery

These proposals, while not receiving the full assent of the Sub-Committee, were referred to the different national committees for further discussion and criticism, whilst awaiting from governments their observations on the draft Convention and the accompanying note which has been drafted by the mixed committee of insurance and legal experts

The present position is, accordingly, that a Convention has been submitted to the various governments for consideration, and this has been accompanied by a note contemplating the establishment of a system of guarantees for users of scientific discoveries, in the form either of mutual insurance or compensatory funds or both, and eventually the establishment of a fixed scale of insurance premiums in private companies

This note is the outcome of the criticism of the draft scheme from industrial opinion, notably in the United States of America and in Germany, which indicated that the Convention would only be acceptable if accompanied by a note guaranteeing industrialists, through some system of insurance, against fresh liabilities arising from royalties due to men of science and inventors The uncertainty of the representatives of British, French, and other insurance companies regarding the nature and extent of the risks which they might be called upon to assume under the proposed liabilities led to the convening of a small committee of insurance and legal experts, which met in Paris in December 1929 and March last and drafted the note to which reference has been made

Meanwhile the fundamental idea of scientific property gains ground every year, and the absence of protection for scientific or theoretical discoveries is recognised more widely as not merely anomalous, but also unjust Mr F H Carr, for example, in a presidential address to the Society of Chemical Industry, referred to the desirability of finding methods of remunerating those who have contributed to industrial invention by researches freely published in scientific journals While the bulk of the controversy over the proposal of the Patents Committee of the Association of British Chemical Manufacturers regarding "dedicated patents" has centred round the efficacy of the protection they offered for the fine chemical manufacturer during the expensive development work required before chemical or biological products of this type can be marketed, the right of the discoverer to some reward has not been overlooked. As Senator Ruffini pointed out in his original report, the only result of withholding protection from therapeutics, as in the French and Italian patent systems, is that the industrialist is allowed to exploit the invention advantageously through the trade mark or registered name device, reaping the reward which might otherwise have fallen to the man of science, at least in part, the advantages to the public health are purely imaginary

There are, indeed, those who, prompted by the growing evil of 'paper patents' created, notably in industrial chemistry, by the intelligent forecast, question the suitability of our whole patent system,

with its basis of invention, to a modern industry in which the major advances are now almost always the result of organised scientific research and team work in which individual inventive ability or ingenuity plays a subsidiary part.

The present system admittedly refuses protection to a scientific discovery of first-class importance, and it is often impossible in a mass of patents to sift out the true knowledge from mere predictions which may or may not be verified by experience Consequently, the public receives no real disclosure in return for the protection In such circumstances, while the industrial research worker remains outside the Convention, any measure which encourages the growth of scientific research by offering real reward to scientific discoveries may be of real benefit to industry At least some sections of industry to-day owe their difficulties in part to a lack of contact between their technical staff and workers in pure science Fundamental scientific research remains the most important fertiliser for industrial research and development, and with the increasing mechanisation of our daily life and the intensive exploitation of the world's resources, its importance will become ever greater

The use of the term 'Scientific Property' in the draft Convention is perhaps something of a handicap It is liable to give a misleading impression and, in the opinion of some, its use has constituted an obstacle to progress, the word 'property' having caused apprehension among manufacturers At the last session of the International Committee, the use of such expressions as "the right of the scientist to his discoveries" or "in the remunerative utilisation of his discoveries" found powerful advocacy, but in view of the general use of the expression and its connexion with the established terms 'Artistic Property', 'Literary Property', the Committee, however, decided that a change was inadvisable, if not impossible, now that the Convention had been drafted

The Italian National Committee has set an example which might well be followed by others The idea of protecting scientific property has been raised at an opportune time, and the six years or more which have elapsed since the inquiry and study of the subject were first commenced is none too long a period It is to be hoped that the question will receive closer attention in Great Britain than has yet been the case, and that there will be no attempt made to curtail discussion or precipitate a decision by this or other governments regarding a Convention which may, indeed, prove impracticable, but may equally prove a valuable stimulus to scientific research and discovery

The Anatomy of History.

Human History By G Elliot Smith. Pp. 509. (London Jonathan Cape, Ltd, 1930) 21*s*. net

TWO problems, above all, have engaged the attention of thinking men, since man first began to think the 'riddle of the universe' and the 'meaning of history' The study of each has come to have its proper technique and discipline But central in one, and conspicuous in the field of the other, stands man himself the 'proper study of mankind' is at the same time anthropology and *literæ humanissimæ* Like the 'man in the street', with his guesses at 'what we are and whence we came', the anatomist, too, "cannot help puzzling over the behaviour of his fellows" and studies "the dead past of man and his strivings", mummification, gold-quest, warfare, and the like, "as a means of interpreting the living present"

The philosophy of history, as Dr Elliot Smith, in the light of his special skill, expounds it, is a simple one "it would not be an exaggeration to say that civilisation was evolved out of man's endeavours to understand the constitution of his own body and to preserve the life that animated it" Taking account of recent discoveries about primitive man, his early civilisations, the 'legacy of Greece', and prehistoric Europe, his object is "to search for the deep motives that have shaped man's career, and to call attention to the vital factors in human thought and behaviour, which have been ignored by most writers" (p 13)

Among these "vital factors", on which the "fabric of civilisation" was built up, he reckons "ideas of the function of the heart and blood, the breath and moisture, the placenta, and the hypothetical 'life substance'" (p 13) He thinks that "all man's early nature-studies were self-centred and in the last resort were related to the expressions of life in his own body" A similar notion underlay the "Physical Realism" of the late Thomas Case, but that was not circulatory philosophy, but muscular, as became one who was a cricketer, not an anatomist Whither, then, does this transcendental omphaloscopy lead us? What is the meaning of "Human History"?

To appreciate the argument, account must be taken of the author's "new emphasis on the fact of the continuity of culture both in time and space", on which, however, he has repeatedly insisted elsewhere What the "principle of continuity" explains in geology and biology, the "tyranny of tradition" effects in "Human History" Yet there was apparently a catastrophe, somewhere

and somewhen for whereas "primitive men were decent, generous, and peaceful", mankind has, alas! somehow "acquired culture, and with it social unrest, dangerous practices, and methods of cruelty" An earlier exponent of the same theme ascribed the Fall to an apple After reading "Human History", one suspects the placenta

Broadly, then, human history is a drama in three acts With two of them, other writings of Dr Elliot Smith have already made us familiar, but the restatement of his views is welcome, not least as an illustration of that 'continuity' through which ideas, essentially the same, become *diablement changés en route* For amid the "tyranny of tradition" we have glimpses of mute inglorious inventors, outside early Egypt, and antecedent, the Chellean method of flint-chipping, which "originated in one spot, where a pioneer invented it" (p 95), the "relatively slight change necessary to attain such greater efficiency" as distinguishes Acheulean technique from Chellean (pp 97, 115), and then "a new genius arose and invented the technique known to us as Mousterian" (p 97) What a pity that the new material from the Bambata Cave in Southern Rhodesia comes just too late to illustrate, in thousands, the "relatively slight changes" necessary to replace traditional Mousterian into a specific local 'industry'! What an instance of 'continuity' defeating 'tradition', and how difficult, except for a biologist, to distinguish this from "some process of so-called evolution", which by mere "tyranny of tradition" still means for many people, since the publication of the "Early History of Mankind" and the "Evolution of Culture", the survival of the fittest among "slight changes necessary to attain such greater efficiency" innumerable and ubiquitous, and we may note that it is on the morrow of such momentous pause in the record as marks the geological 'continuity' between Chellean and Acheulean gravels that the new theory postulates one "individual of outstanding genius", to make all the difference between Chellean and Acheulean technique

So too, among uncompromising denials of the influence of geographical surroundings on mankind (p 253), there are significant admissions Though the "pronounced monogamy of the Food-gatherers" awaits explanation, "economic causes may well play a part It may not be possible for a man to keep more than one wife" (p 263) The Melanesians (p 157) "probably only reached new islands when they were swept by the forces of Nature out of their course". Worse follows, "it may also be something more than a coincidence that the Hittites arose on the edge of the salt treeless tract in Central Asia Minor" (p 287) Worst of all, "the natural crop of barley, which was growing wild on the banks of the Nile, seems to have provided the lure to attract the earlier settlers in Egypt" (p 272), and though, of course, "some man of exceptional insight imitated the natural processes", the vital importance of irrigation "impelled the Egyptians to study the habits of their river" (p 278), and "hence communities became herded together in villages, and people were forced into more intimate association", wore clothes, buried their dead, and set out on the 'life-quest' and all our woe, all unaware that geographical facts such as "the habits of their river" were incompetent to modify the habits of a people Or was some "individual of outstanding genius" the first to scramble up the bank to keep his feet dry? In fact (p 291), "we may draw the only possible inference and assume the invention of agriculture in Egypt, where Nature was annually pointing the way so clearly" A very naughty river, to break the 'continuity' of human history so!

More generally still, among mammals, "those which wander away from their original home and become subjected to new environment and new conditions of life, new food to search for, and new dangers to overcome, are more rapidly transformed than those that stay at home" (p 159), and this is explicitly applied to Mediterranean man Change of scene seems, after all, to suit those "individuals of outstanding genius" whose breaches in the "tyranny of tradition" illustrate the "principle of continuity" in biology Instances abound in "Human History"

"The first hunting-grounds were only attractive if flint was to be found near them" (p 95) "the increasing cold must have tried these roaming hunters severely", and "in the Acheulean strata are the ashes of the first hearths" (p 96) So ancient is the habit, universally diffused to-day, of "borrowing a light" But who borrowed first, and from whom? Or did more than one 'pioneer' strike a light while striking a flint? Even among 'grassland' man—a particular *bête noire* of continuous history—"the population was kept small by the exigencies of the rainfall alone" In Greece itself the emancipation of human reason was not quite complete, for this country (p 431) had been "continually subjected to the cultural influences diffused in the waters that bathed its shores", an interesting glimpse of the physics of diffusion

Another very welcome shift of view is the generous

recognition of Tylor's "luminous expression" of the "principles that should inform any attempt to interpret the behaviour of men under conditions of civilisation" True, the old leaven festers still, in the reference (p 329) to a "theory of universal animism which distorted the vision of ethnologists for more than half a century" But as it is admitted that Tylor "discovered so many examples of a peculiar phenomenon the attribution of life and mind to inanimate objects", we are not far from the view that a certain outlook on human history, like Chellean flint-chipping, "originated in one spot, where a pioneer invented it"

For the Fall to have had such disastrous consequences—"social unrest, dangerous practices, and methods of cruelty"—the state of innocence must have been innocent indeed, and the rehabilitation of the 'noble savage' is one of the more important of Dr Elliot Smith's contentions For if civilisation, with all its evils, has resulted from man's endeavours "to understand the constitution of his own body and to preserve the life that animated it", what risks we run from the teaching of physicians and anatomists! What is odd, however, is that the "decent, generous, and peaceful" food gatherers should for millennia and with such uniformity (or was it 'continuity'?) have missed the significance of the placenta for it is admitted (p 330) that "the study of the phenomena of birth is as old as man himself" As is insisted in the same context (p 329), "even serious investigators by pushing just a little further than the evidence warrants the application of a bright idea, can make it nonsensical" and the reviewer craves pardon in advance, if he has played the pioneer in that way But is the evidence as to the distribution of placenta-cults, or flag worship, or other "dangerous practices", so complete as to justify inferences from presumed lack of them among "food-gatherers", or the complementary conclusion that the occurrence of practices resembling them results from diffusion of food-producing culture among peoples who do not in fact produce food?

The stress justly laid on the regional character of the Upper Palæolithic cultures—in spite of the corollary presumably postulating regional pioneers'—makes more surprising Dr Elliot Smith's insistence on the brevity and insignificance of the phrases usually described as Neolithic, "anywhere except in Britain and western Europe" That the "real revolution" was the replacement of *H neanderthalensis* by *H sapiens* may be admitted, without overlooking the significance of the new technique of grinding and boring In the Philippines, for example, there is stratigraphical evidence for two well-marked cultures with more or less 'polished' implements, accompanied by pottery, between the Upper Palæolithic and the Iron Age layers Here it is not the Neolithic that is absent but the Bronze Age, which means so much to Dr Elliot Smith But, as he admits in another context (p 106), "so again in the Neolithic Age a succession of new waves of population intruded from time to time, each bringing some new contribution"

There is, however, a reason for this apparent neglect of Neolithic phases Unless the very short duration here assigned to them, particularly in the north-west, is admitted, it is difficult to establish the remarkable precocity of culture in Egypt, which is central in Dr Elliot Smith's interpretation That many elements of European civilisation spread from the Near East, is admitted The question is whether other parts of the Near East themselves obtained them by 'diffusion' from Egypt, and as, until lately, the chronological inferences, from sequence dating and stratigraphy combined, were better supported in Egypt than elsewhere, it is obvious that *if* these arts and practices originated in Egypt, their first appearance elsewhere should be subsequent This, however, is just what has to be proved, and the very confident statements of Egyptian priority in "Human History" are not accompanied by evidence more conclusive than what has been so variously interpreted In particular, the geographical distribution (or is it 'diffusion'?) of apparently wild congeners and precursors of the earliest cultivated grain plants cannot really be said to be fully established yet, and in so far as it is approximately known, it seems generally taken to favour Asiatic origin for cultivated grains Since this question of grain crops is as fundamental to the Osirian theory of civilisation as the placenta-cult itself, readers of "Human History" must prepare themselves for another act of faith

Nor is the "ancient tradition of Osiris recorded by Plutarch" more valuable corroboration of the hypothesis of an "individual of outstanding genius" at the beginning of Egyptian civilisation, than is Archbishop Usher's approximation to Prof Breasted's date for this modern version of the Fall For if the Egyptians were "living the life of Natural Man before they began their pioneer work", Osiris lived before the first potter, and this helps to explain a certain reluctance to grant high antiquity to the Badarian precursors of pre Dynastic pottery But Osiris is represented (p 253) as

having made his amazing innovations not much earlier than 4000 B C What, then, becomes of the ceramic priority of Egypt ? For the correlation of this phase of its culture with the Cretan series is at the top, not the bottom, of the twenty feet of pot infested house-debris which underlies the first Bronze Age layer And is not the admission (p 279) that "like all human communities throughout the ages [the Egyptians] listened to the voice of authority", rather destructive of the view that it was because they were the first people to do so, that they involved themselves, and us all, in the 'dangerous practices' of civilisation ?

Among these practices, as has been noted already, those based on observation of vital processes are represented as of central significance Here a strong case is presented for regarding this whole group of beliefs and customs as concerned less with the reproduction of life, by so-called 'fertility' rites, than with the maintenance and enhancement of existing life—the life of the performer, or of someone whose continued existence seemed indispensable to him This is a fresh and fertile suggestion, which it would be impossible to discuss adequately here, further than by noting how that notion gained new and tremendous vogue, as soon as efforts to maintain and enhance were transferred from *this* life to another, and men distinguished the transcendental maintainer of life from their own temporal chieftain The relation of this view of early culture to those propounded already in Christopher Dawson's "Age of the Gods" and Hocart's "Kingship" will be obvious

At last the curtain rises on Act III Dr Elliot Smith has discovered the Greeks More precisely, he has gone a step further than Ure's "Origin of Tyranny" That was itself a venturesome book, wherein the invention of coinage, and the mobility thus given to wealth, were claimed as the material cause of that emancipation of individual enterprise from restrictions of communal ownership which in turn made possible the democratic movement in Greek city-states, with all that this implied Dr Elliot Smith's corollary is that there was concurrent emancipation from the "tyranny of tradition" in the world of thought, with the result that "mankind recovered intellectual freedom", even if people still do not always avail themselves of it to rationalise their lives Yet mark the tragedy, that so high an achievement of this people of "transcendent genius" should be correlated in 'Human History" with such a merely geographical accident as the occurrence of gold in the Pactolus river !

Not that 'continuity' was lacking even here Dr Elliot Smith has satisfied himself that there was "no break in the development of style" between Mycenæan and geometrical art (p 431), also that the Doric column was "derived ultimately from Egypt" because "all later fluted columns must be derived ultimately from these Third Dynasty types" Such was the "tyranny of tradition" until the invention of coinage, though Dr Elliot Smith is insistent that it did not apply to round pillars, nor to square (p 451), which "given the idea of a pillar, might arise independently in any country and any number of times" But why ? Are "individuals of transcendent genius" so common in the building trade ?

But if Greece learned Egyptian notions by 'diffusion', it also taught that way It is "an excellent illustration of the general theorem of the diffusion of culture", that "Greece provided most, if not all, the principles which distinguish" not only "the higher culture of Western civilisation" but also "those of Asia and pre Columbian America" This leads straight to the thesis of the author's "Elephants and Ethnologists", but with greater insistence on the Hellenic (and therefore ultimately Egyptian) source of the "connexions between the Ægean, Scythia, and India" and therefore of "results which hitherto have been unduly minimised, if not wholly ignored" (p 462) Thus we have "clear evidence of Cretan influence in Turkestan in Middle Minoan times" (p 467) which will be news to the specialists That Ionian rationalism may have inspired the 'rational philosophy' of the Buddha, has been suggested by others, what is less easy to accept is that "there was no architecture in India till the advent of Buddhism" (p 472), especially as the ancient cities at Harappa and Mohenjo-Daro are mentioned immediately after Eventual limitation to *stone* architecture (p 474) is further qualified by excluding not only the stonework on those northern sites, but also the 'megaliths' of southern India, and the claim for Hellenic initiative would seem to fail, in face of evidence for Achæmenid models (p 476) The case is indeed given away on p 477 "could we discover what the wood carving was like" which dominates early Indian stonework "we should be more certain of the history of early Indian art As it is, we can only judge from the surviving stone reliefs" It is admitted also (p 476) that the 'honeysuckle' and other ornaments common in Greek architecture "were employed in earlier Assyrian" as well as in Persian Is it true, further, that the halo is "used in Greek

paintings as an attribute of gods" (p 479) before Christian times?

Such perplexities may result from the condensation evident in this latest section of "Human History", and the survey of events in the west, and Greek influence on Christian and Moslem thought, is more summary still But in the plan of the book there is a reason for this It was the achievement of the Greeks "to restore to human reason the freedom it had lost" when man "began to devise civilisation" and "became entangled in the shackles of the theory of the State" (p 497) The "conflict between the rationalism of Hellas and the superstition of Egypt" is, however, not over In the words of Dr Elliot Smith's epilogue, "it depends on the human population of the world themselves, which will win For thought and courage can decide the issue" Of both there is abundance in this book, which is appropriately dedicated to the "vision and courage" of another "pioneer", Dr W J Perry J L MYRES

Wind and Water

Wind and Water By Manfred Curry Pp 28+120 plates (London *Country Life*, Ltd, 1930) 25*s* net

THIS is a handsome quarto volume of one hundred and twenty full-page photographs, the first half of which are studies of sea and lake, the second half of sailing yachts The plates are a selection made by Mr Curry from many thousands taken by various photographers The smooth paper on which they are reproduced is free from pernicious glaze and restful to the eye

Some of the wave studies are of exceptional merit One by F S Schensky showing the back of a wave rushing on the cliffs of Heligoland admirably conveys the speed of the surge, and another by the same photographer of the front of a great breaker (presumably on the same shore) is an effective counterpart The combing crest rises above the sky-line and is cambered in the centre The moment of exposure of the plate has been exactly timed for the closing of the cusp upon the cushion of water in front, a critical moment seldom recorded

Of the lake studies, two stand in happy contrast The first is of Lake Constance in a Föhn wind, with lines of breakers below and long rolls of stormy cloud above, separated by the serrated summits of a mountain range—a beautiful composition The second is of a tarn in Switzerland, in the clear waters of which the mountains

View the stillness of their aspect

more perfectly than is possible in the larger lakes fed by the turbid waters of a glacier stream. The study of the Walensee is an effective rendering of a contrast which always exercises an imaginative appeal—that of a vertical cliff of massive rock with the level lines of smooth water and a low shore in the distance

There are two fine photographs taken at sea, both by Count Larisch, one of which shows the rush of a single wave rising high above the line of sight, the other a remarkable effect of rigging and spars, and a heeling deck awash in a heavy sea

A number of photographs of yachts sailing will be of interest to those versed in the sport, but are for the most part lacking in pictorial effect

The introductory letterpress is in two sections, of which the first and longer relates to waves and wind Mr Curry refers to his discoveries about waves He has indeed made observations and formed opinions, but I venture to suggest that a further study of the work which has been published upon this difficult subject would lead to a modification of the views which he advances, particularly in regard to the preponderating importance which he attributes to the friction of wind in the formation of waves and the friction of the sea bottom in deflecting their direction in the neighbourhood of the shore

With the comments of the author upon the relation of modern aerodynamics to yachting I am not competent to deal, and of this section of the introduction I can only say that Mr Curry's enthusiasm for his sport makes agreeable reading even for one who is not a practical yachtsman

VAUGHAN CORNISH

Mars 226591

Le planete Mars etude basée sur les résultats obtenus avec la grande lunette de l'Observatoire de Meudon et exposé analytique de l'ensemble des travaux exécutés sur cet astre depuis 1659 Par E M Antoniadi Pp iv+240+10 planches (Paris Hermann et Cie, 1930) 80 francs

THIS is unquestionably one of the most important books on Mars ever published, and it will always remain a standard work of reference for the period covered by the author's researches

The book opens with a chapter on the planet in antiquity which illustrates the writer's wide knowledge of the literature and astronomy of ancient times But it is especially with our knowledge of Martian topography as revealed by the telescope that it is concerned, and Chap ii contains an account of instruments, stations, and conditions

most favourable for a successful study of this interesting planet It will be noted here that M Antoniadi—who first in 1909 had the immense advantage of using systematically for the study of Mars the great 32 7 in refractor of the Meudon Observatory, through the kindness of Dr H Deslandres (then its Director), to whom this book is fittingly dedicated—himself prefers refractors to reflectors, but it will be something of a surprise to some readers to find that he does not consider the secondary spectrum a serious drawback in the use of such instruments for planetary work The view of Prof Ritchey, which he quotes, that an important factor in the success of the Meudon telescope is the height of the object glass above the surface of the ground, is doubtless correct Indeed, it has long seemed to the reviewer that the unsteadiness of the images so often given by reflectors—especially when employed in the open —arises largely from the fact that their specula are situated in the disturbed conditions near the ground level, as well as from the usual tube currents Foggy weather, of course, naturally finds approval where large apertures are to be used, as also does a considerable altitude with the view of getting above the denser strata of the atmosphere, but the habit of employing diaphragms to improve the steadiness of the images is strongly criticised as seriously diminishing the separating power so essential in the resolution of planetary details

The following chapter contains details of the orbital and physical elements of Mars, after which we come to a general account of the surface features as telescopically observed, including changes of colour, " the illusion of the canals ", the polar caps, clouds and other atmospheric phenomena, the habitability of the planet, and the two satellites This concludes the first part of the volume

Part 2 consists of a very full and detailed descriptive account of the planet's surface, and the changes, seasonal and otherwise, which have been observed to take place in the several markings These details are well illustrated by a number of drawings, mainly by the author The nomenclature employed is that of Schiaparelli, but this has been extended by the adoption of names from the maps of Lowell and Cerulli, and in the case of a number of more recently detected features the names have been assigned by M Antoniadi himself

It is to be noted that in general this descriptive part of the volume is intended mainly as a presentation of the author's own researches, but the history of our knowledge of the various features is carefully traced from earlier records and supplemented by the work of contemporary observers Great care has been taken in the selection of the material presented, and there are abundant references to the work of members of the Mars Section of the British Astronomical Association, of which M Antoniadi was for several years the director

Of course, the great value of the work lies in the fact that it presents the conclusions of a particularly able and accurate observer using one of the very best instruments in the world, and, moreover, one who possesses very great skill as a planetary draughtsman It will be clear to the reader that its inspiration lies in the wonderful views of Mars shown to the author by the great telescope at Meudon in 1909 It was these views which led to his final conviction that the so-called ' canals ' of Schiaparelli and Lowell were illusory, in the sense that their geometrical appearances, together with such phenomena as their occasional gemination, were the result of optical and physiological causes In particular, the straight and linear appearance of many of these features was announced as nothing more than a consequence of integration by the eye of irregular spots and markings which were in general beyond the reach of distinct vision with the relatively small apertures usually employed up to that time That there is some objective basis behind the Schiaparellian canals is, of course, fully recognised This is illustrated in the chapter on " The Illusion of the Canals ", and for further details the reader may turn to the 1909 Report of the Mars Section of the British Astronomical Association published in vol 20, part 2, of the *Memoirs* The previous scepticism concerning the reality of these geometrical features will be well remembered. While some assiduous and trustworthy planetary observers using instruments of moderate size recorded a number of them, there were others, such as N E Green, E W Maunder (see a paper in *Mon Not Roy Ast Soc*, vol 63, p 488, by E W Maunder and J E Evans), and Cerulli—to mention just a few—who consistently maintained that they were capable of an optical explanation It was, however, the great Meudon refractor which actually showed to M Antoniadi in 1909 those irregular spots and broken up features into which the canal system is so very largely resolvable when adequate telescopic power is employed

There is, however, one point to which it seems needful to direct attention in order to avoid further confusion Most unfortunately, ever since the days of Schiaparelli, markings of very different characteristics have been designated ' canals ', namely, broad dark streaks on one hand and fine spider-web-like

lines on the other This is partly attributable, no doubt, to considerable changes in the intensity and breadth of some of these markings, but so long as the term 'canal' is applied indiscriminately to all the linear markings and streaks, the general statement sometimes met with, that photography does not show the canals, is apt, if unqualified, to be misleading The 'canals' bounding Elysium, and those in the neighbourhood of Solis Lacus, as well as strong broad features, such as the Casius and Nepenthes-Thoth have been for several years past, do come out very plainly on the photographic plate Moreover, such features were seen and drawn before Schiaparelli's time, and, in general, so far from being straight, many of them are very distinctly curved Of the objective existence of these markings we may feel assured As in the case with the term 'mare' for the designation of lunar features, it may now be difficult, perhaps, to give up altogether the use of the term 'canal' for the linear markings of Mars, as M Antoniadi has done, but the retention of the same term for objects of widely different characteristics can scarcely be other than a fruitful source of misunderstanding and confusion

Another point which M Antoniadi's researches—and, indeed, the work of many other observers, like Prof W H Pickering, who has similarly devoted many years to the study of Mars and its seasonal changes—reveal with great clearness is that, despite its shortage of water, Mars is by no means as yet a dead world The work under review is not directly concerned with those recent methods of investigation by photography in light of different wave-lengths or the measurement of the surface temperature with the thermo-couple which have gone so far to establish points of analogy with the earth, but the visual revelations of the telescope described by M Antoniadi, such as the drift of the clouds and other manifestations of Martian meteorology, the seasonal changes in the colour, form, and intensity of dark markings like the Syrtis Major, the occasional developments and changes on an enormous scale like those observed in recent years in the Solis Lacus and Noachis regions of the disc, all indicate that Mars is still very much alive and full of interest for the student of its surface and physical state

At the end of the volume are a number of plates which are exceedingly well reproduced The first five are maps and these are followed by plates containing four whole-disc drawings of the planet as seen at Meudon during the apparitions of 1909, 1911, 1924, 1926, and 1928–29

Our Bookshelf.

L'art primitif Par Prof G-H Luquet (*Encyclopédie scientifique Bibliothèque d'anthropologie*) Pp iii+267 (Paris Gaston Doin et Cie, 1930) 30 *francs*

IN "L'art primitive" M Luquet turns once more to the problem of the origin of art Very briefly, his theory is that two forms of representative art are to be distinguished First, there is the classical art of the adult, no longer to be regarded as the one and only form Secondly, there is a form of art which is called 'primitive' Under this heading, on the ground of their common characteristics, he groups certain tendencies opposed to those of the adult classical art—the art of children, some adults ("même des professionnels"), savages, and prehistoric man Both in the individual and in the history of the human race, the urge to artistic representation arises in the same way—an accidental production or discovery of a resemblance to a real object Hence comes a desire for the execution of a purposive reproduction, which in turn gives rise to the pleasure of creation In this disinterested art lies the germ of magical art, but the pre existence of the artistic product before its magical use is a necessary postulate Further, while 'classical art' is static, primitive art is dynamic, by an intellectual realism it sees the whole story in time and space Hence the representation of invisible parts, distorted perspective, and duplication

M Luquet argues his case ably, with illustrations drawn from primitive art and from infant psychology The book is stimulating but far from conclusive Savages are not children, whatever may be the similarities in the artistic products of each Even if fortuitous resemblance gives rise to artistic activity in both cases, the savage brings a range of relatively highly developed concepts to bear upon his problem from the very first There is, in fact, no reason why the magical impulse should not be present from the very beginning The real analogy is not with the art of children, in which it is difficult to isolate the spontaneous activity from the imitative, but with such an urge as that for jewelry, in which an artistic product is the ultimate outcome of the magical efficacy of a natural object, afterwards imitated in some precious or magical material—for example, coral—and finally desired for its beauty or intrinsic value without reference to any original meaning

Some Applications of Organic Chemistry to Biology and Medicine By George Barger (The George Fisher Baker Non resident Lectureship in Chemistry at Cornell University, Vol 5) Pp v+186 (New York McGraw Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1930) 12*s* 6*d* net

THIS volume represents the fifth of a series in which are reproduced the lectures delivered by distinguished visitors invited to Cornell University in accordance with the terms of the George Fisher Baker Foundation The purpose of this Foundation is to facilitate intercourse between scientific

workers of different nationalities Appropriately, Prof Barger deals in his introductory lecture with the history of internationalism in science The belief that scientific research is one of the most international forms of human endeavour, possibly only second to music in this respect, is illustrated by a remarkable range of examples that connects the brotherhoods of the schools of Vesalius, Fabricius, and other great masters of the Italian universities of the sixteenth century with the international contributions that led to the isolation, identification, and synthesis of adrenaline Many other examples may be derived from the five lectures which follow and which deal with important recent developments in biochemistry The chemistry of the hormones is presented in an able and comprehensive review, no small part of which is devoted to the fascinating story of the steps by which the constitution and synthesis of thyroxin was achieved Other lectures deal with the chemistry of the vitamins, chemical constitution and physiological action, chemotherapy, and finally the nature of the curious blue adsorption compounds of iodine A very interesting and stimulating volume

Niels Henrik Abel eine Schilderung seines Lebens und seiner Arbeit Von C A Bjerknes Umgearbeitete und gekurzte Ausgabe aus Anlass von Abels 100 jahrigem Todestag von Prof Dr V Bjerknes Ins Deutsche übertragen von Else Wegener-Koppen Pp v+136+1 Tafel (Berlin Julius Springer, 1930) 6 60 gold marks

PROF V BJERKNES has condensed the longer work of his father by omitting the details of Abel's mathematical work, so as to make accessible to all the biography of that ill fated genius

Abel was born in 1802 His abilities were dormant until he met with a sympathetic teacher, who soon prophesied his future greatness However, a local reputation in a country like Norway required support from abroad In spite of his poverty, Abel had a paper printed at his own expense and sent a copy to Gauss, the acknowledged leader of mathematical thought, whose appreciation would have made Abel's position secure But the paper was poorly printed, with portions of the argument omitted, and Gauss tossed it aside Later, Abel was given a travelling scholarship, but his resentment prevented him from meeting the only man who could have fully understood his work In Berlin, Abel was welcomed by Crelle, who published in his newly founded *Journal* several of Abel's papers But a professorship in Christiania, which Abel had confidently expected, was awarded to another Fresh disappointments awaited him in Paris He sent to the Academy what is now known as Abel's theorem This should have assured his fame, but by some amazing mischance it was not printed until fifteen years later Long before this, Abel had returned home and for two years struggled with financial cares Then at last recognition came, and in 1829 he was offered a professorship in Berlin Too late! He had died two days before

H T H P

Clouds By Prof Alexander McAdie Pp iii+22 +52 plates (Readville, Mass Blue Hill Observatory)

MORE attention has probably been given to the study of clouds at Blue Hill Observatory, Massachusetts, than anywhere else in the world, and the appearance of a volume containing the cream of the many fine photographs of clouds taken there, in addition to a selection of photographs from other sources, is to be welcomed The reproduction of these varies According to the very high standard of the present day, many of the photographs of cirrus cloud can only be classed as poor, the essential fibrous structure being replaced by a wool-like appearance almost suggestive of fracto cumulus at a first glance Even the comparatively easily reproducible cumulus and cumulo-nimbus are not as a rule entirely satisfactory, a common fault being the total lack of detail in those parts of the cloud that are in shadow Against these drawbacks must be set the exceptionally interesting view point from which some of the low forms of cloud have been photographed, and the amount of light thrown upon their physical structure in consequence It will come as a revelation to those who have not had many opportunities of studying clouds from above, the extent to which fog sheets can form 'surges' and cascades when drifting over hills, without being broken up or dissolved

An important feature of the work is the historical sketch with which it opens We cannot recall having seen a more comprehensive guide to the most important attempts at a scientific treatment of the study of clouds, from the tentative observations and speculations of Socrates to the recent intensive study of cloud formations in relation to moving pressure systems made by the French National Meteorological Office Prof McAdie has done good service to meteorology by this piece of work

The Measurement of Men By J A Harris, C M Jackson, D G Paterson, R E Scammon Pp vii+215 (Minneapolis University of Minnesota Press, 1930) 2 50 dollars

FOUR lectures, delivered under the auspices of Sigma XI of the University of Minnesota, are here published as a contribution to the exact study of man by means of measurement Prof L Arthur Harris deals with "The Measurement of Mankind in the Mass", an exposition of statistical methods and some results, Prof Clarence M Jackson deals with "Normal and Abnormal Human Types", Prof Donald S Paterson with "Personality and Physique", and Dr Richard E Scammon with "The Measurement of the Body in Childhood" Prof Jackson gives some interesting comparative figures from the army and from university students which will probably be new to most English readers, while Prof Paterson makes some amusing and destructive comments, supported by statistics, on the distinction popularly drawn in the United States between the mentality of blondes and brunettes, and on the claims of physiognomy and phrenology to gauge character

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*]

Emergent Evolution

IT is curious that while the concepts of physics have been undergoing drastic revision, the same has not happened with regard to biology It is true, Dr E S Russell has recently examined very critically what is meant by organic development, but very much more is still necessary in respect of other conceptions of biological science Here I refer particularly to the notion of 'emergence' in evolution—by which, Dean Inge says, we assert and deny change in the same breath! The conception, as it has been stated so far, involves confusion, and it would be well worth while for someone familiar with the formal methodology of science to attempt a very critical discussion of the matter

The notion of emergence is illustrated by the formation of water from its elements There is nothing in the reactants, it is said, which suggests the liquidity of the resultant liquidity, therefore, is said to 'emerge' from the reaction of oxygen and hydrogen to form water But may we not regard these reactants as mass-points in a Newtonian medium, moving in accordance with Newton's laws, and attracting and repelling each other with forces which are functions of their distances apart We describe such a system of mass points by position- and force-co ordinates Since the mind body problem is the same in our perceptions of the properties of reactants and resultants, may it not be regarded as cancelling out, so that liquidity in the resultant *is* the changes of co ordinates? Of course, we may make an analogous statement with regard to an electronic medium

Again, the properties of the atom are said to 'emerge' from some configuration of the elements of the atom But that configuration, to J J Thomson, was not the configuration imagined by Rutherford and Bohr, and, again, not the configuration of current physics Yet the 'emergent' properties are still the same ones Finally, we can make systems of equations representing the thermodynamic probabilities of two or more gaseous systems and we can deduce from those equations that the entropy of a combined system is proportional to the logarithm of the combined probabilities May not the latter equation be said to 'emerge' from the former ones, and yet does it contain any terms that were not in the equations from which it was deduced? Is not what 'emerges' *a relation made in the mind of the investigator*? Were not the electronic configurations simply in the minds of mathematical physicists rather than in the atomic systems?

These examples are very simple ones what emergent evolution rather contemplates are the origins of human mentality, 'values', the religious feelings, and God Science now, in its modesty and self critical outlook, is being said to admit, or at least tolerate, speculations with which, in a more assertive (or truculent) phase, it would have nothing to do Has not the time come when notions such as that of 'emergence' and 'organicism' should be dispassionately and critically (or even unsympathetically) considered in the interest of sound thinking?

JAS JOHNSTONE

University, Liverpool

Embryology and Evolution

I SHOULD like to comment on two letters by Mr Haldane one on "Natural Selection Intensity as a Function of Mortality Rate", in NATURE of Dec 6, and the other on "Embryology and Evolution", in the issue of Dec 20 In the first, Mr Haldane criticises as "fallacious" Prof Salisbury's argument that mortality amongst plants is mainly confined to the seedling stage and that at this period natural selection mainly works He goes on to consider a case where two races vary as to a single character! Now, this is a travesty of what occurs in Nature Two allied races do not differ from one another in a single character they differ in a multitude of minute points, and it is quite impossible to say whether one or another of these points determines their survival The 'characters', in fact, are mere abstractions The organism is a whole, and the characters are the expression of its constitution, in a word, of the vigour of its reaction to its surroundings The whole point of Prof Salisbury's argument was that natural selection chooses the most vigorous, not that which possesses some special character, and this argument I believe to be perfectly sound

In his second letter Mr Haldane objects to four of the statements in my reply to Prof Gates I shall deal with these seriatim

(1) Mr Haldane claims that some microscopists have seen 'genes' What they have seen are segregations of material in the stained and fixed chromosomes which they have identified as genes—a purely hypothetical conclusion He further says that the presence or absence of a 'trabant', that is, not a gene but a small chromosome, makes a difference in the constitution of the plant *Matthiola* This is quite possible, and I shall be glad to have it demonstrated Prof Gates was I think, the first to show that an extra chromosome made a difference to the appearance of the mutant

(2) Mr Haldane asserts that scores of cases are known where in interspecific crosses characters behave in a Mendelian manner, that is, are due to genes All I know on this subject is that my friends who are systematists, and have devoted their lives to the study of species and races deny that such is the case Of course, a mutant such as the domesticated race almost always 'mendelises' when crossed with the wild type, that is just what distinguishes a mutant from a racial character, and the case quoted by Mr Haldane is such a cross

(3) Mr Haldane states that autocatalytic reactions are common in physical chemistry By this is meant reactions in aqueous solutions which are accelerated by the products of the reaction I put this question to three first class chemists, all of them fellows of the Royal Society and one of them a bio chemist, and as they were all unaware of any such case, I prefer to accept their testimony

(4) Mr Haldane objects to my posing the alternative of the organs being preformed in miniature in the embryo or being due to an 'unknown cause' He says that bone is formed by an enzyme 'phosphatase' This is a mere quibble Enzymes are *means* employed by the embryo to develop its powers, and their orderly appearance is just as much a mystery as the appearance of the organs themselves

Mr Haldane's remarks about my refusing to take cognisance of the recent advances of science and his invitation to acquaint myself with the 'facts' of genetics and chemistry I prefer to disregard I have quoted the authorities on whom I rely in chemical matters As to genetics, I have served for seventeen years on the Council of the Institution to which Mr

Haldane is attached as statistician, and I have watched all the work going on there, and the more I see of it the more I am convinced that Mendelism has nothing to do with evolution

E W MACBRIDE

43 Elm Park Gardens,
Chelsea, S W 10,
Dec 23, 1930

THE discussion between Prof R Ruggles Gates and Prof E W MacBride, in NATURE of Dec 6, bears in an important way upon the philosophy of science May one without authority in biology offer what he hopes may be a useful contribution from the philosophical point of view?

It is the function of the scientific man to discover facts, to endeavour to co ordinate them, and by generalisation to build up a useful scheme of hypo theses Such a scheme must be a deterministic scheme or it cannot be useful, that is, it cannot be used to forecast further facts When Prof MacBride writes of mechanical hypotheses, he refers, presumably, to such a deterministic scheme Whether the resulting scheme represents the truth is not the business of the scientific man as such, but of the philosopher

As a philosopher Prof Gates may believe himself to be a "mere mechanism" or a Drieschian entelechian organism For science this is beside the question A scientific man must continue to have faith in "so called mechanical hypotheses", or, as Prof Gates says, "there would be no further incentive to experimental embryology", and his function would cease As a philosopher he may doubt whether such deterministic schemes will ultimately prevail, but as a scientific man he must carry on

C O BARTRUM

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Hampstead, London,
Dec 10

The General Factor in Spearman's Theory of Intelligence

SPEARMAN'S theory may be summarised as follows

(1) A mathematical theorem, that when all the tetrad differences such as $(r_{ab}r_{cd} - r_{ac}r_{bd})$ formed from N variables $a, b, c, d,$ vanish, each variable may be considered as the sum of two parts (or 'factors') which are numerical multiples of a general factor g (the same for every variable) and of a specific factor s (different in each case) These $N+1$ factors are all uncorrelated with each other

(2) The attribution principally to mere error of sampling of the non vanishing of the small tetrad differences formed from dissimilar mental measurements

(3) The interpretation of g as general mental energy, and of each s as a specific ability

Spearman's proof of (1) is given on p v of the appendix of his "Abilities of Man" (1927) The value of g (there called η) is given in the form of a complicated determinant involving a variable ι which is undefined except that it is "any new variable un correlated with all the others" No clue is given to show how the determinant was obtained The object of this letter is to point out a straightforward method by which an equivalent but much simpler expression can be obtained, and to show the nature of the mysterious variable ι, concluding with a very brief discussion of the psychological interpretation The error of sampling is too large a subject to consider here.

To obtain an expression for g, first suppose that the variables *can* be divided into general and specific factors, that is, suppose that

$$a = m_a g + n_a s_a,$$
$$b = m_b g + n_b s_b, \text{ and so on,}$$

where the m's and n's are constants, but g and the s's variables, no two of which are correlated (It is con venient to use *standard measure* for the variables this ensures that all the means are zero and all the standard deviations unity) We find that the tetrad differences all vanish and hence that $\{r_{bc}/(r_{ab}r_{ac})\}^{\frac{1}{2}}$ has a value depending on a alone, so that it may be denoted by μ_a Now choose multipliers $w_a, w_b,$ such that the correlation between g and the combined test $t = \mathrm{S}w_a a$ may be a maximum This gives $w_a = \mu_a/(\mu_a^2 - 1)$ Then form an estimate of g in the usual statistical way (assuming *linear* regression) by using a regression equation $g = r_{tg}\sigma_g t/\sigma_t$ This, of course, will not give the exact value of g Call the unavoidable error $k\iota$, where ι is a variable and k a constant chosen to make the standard deviation of ι unity This leads to the expressions

$$g = k^2[\mathrm{S}\{a\mu_a/(\mu_a^2 - 1)\} + \iota/k]$$

and $$s_a = (\mu_a^2 - 1)^{-\frac{1}{2}}[a\mu_a - k^2\mathrm{S}\{a\mu_a/(\mu_a^2 - 1)\} - \iota k],$$

where $k^{-2} = 1 + \mathrm{S}\{1/(\mu_a^2 - 1)\}$

It is easily verified that ι is uncorrelated with each of $a, b, c, d,$

Conversely, whenever the tetrad differences all vanish and in consequence the μ's exist, it is only simple algebra to verify that $a = g/\mu_a + (s_a/\mu_a)(\mu_a^2 - 1)^{\frac{1}{2}}$, with similar expressions for the other variables, and on calculating the coefficient of correlation between any two of $g, s_a, s_b,$ we obtain zero, provided ι is uncorrelated with $a, b,$ In this *converse* work there is no need to assume linearity of regression, which is needed only if we wish to deduce *independence* from zero correlation There is also no appeal to Taylor's theorem For g to be real the coefficients of correlation between $a, b, c, d,$ must all be positive

An interesting example, in which at first sight there appears to be no general factor, is the following

$$\begin{aligned} a &= \tfrac{1}{2}(\phantom{u+{}} v + w + t + p), \\ b &= \tfrac{1}{2}(u \phantom{{}+v} + w + t + q), \\ c &= \tfrac{1}{2}(u + v \phantom{{}+w} + t + r), \\ d &= \tfrac{1}{2}(u + v + w \phantom{{}+t} + s), \end{aligned}$$

where each variable on the right hand side represents the score (reduced to standard measure) of a die We find $r_{ab} = r_{ac} = \quad = \frac{1}{2}$, and so each $\mu = \sqrt{2}$ This gives

$$g = \frac{1}{5\sqrt{2}}\{3(u + v + w + t) + (p + q + r + s) + \iota\sqrt{10}\},$$

and

$$s_a = \frac{1}{5\sqrt{2}}\{-3u + 2(v + w + t) + 4p - (q + r + s) - \iota\sqrt{10}\},$$

so we have resolved the overlapping group factors into the general factor which seemed to be lacking

Some may consider that the occurrence of the chance or uncertainty factor ι in the above result robs it of all real value But if the two factor theory is true, the uncertainty cannot be avoided, for from N equations we cannot determine the $(N+1)$ unknowns (one g and N s's) Moreover, by increasing N the coefficient of the uncertainty term can be made as small as we please However, it may be conceded that to a person who knew nothing about dice, the above expression for the general factor might convey a wrong impression, and to guard against a wrong interpretation of mental tests it is necessary to acquire some knowledge of them apart from the mathematical results It is at once the strength and the weakness of mathematical reasoning that it is generally adaptable to more than one set of circumstances Let psychologists find two individuals who do equally

well at a mental test, but such that one has a large g and small s, the other a large s and small g, and consider whether there is sufficiently good correspondence of these variables with what on other grounds may be considered general mental energy and specific ability Other results, such as the difficulty in transfer of training, may be of service

Further deductions from the above expressions for g and s are being investigated I have been greatly helped by my colleagues, Miss A E M M Dallas and Mr M M Lewis

H T H PIAGGIO

University College, Nottingham,
Nov 22

I QUITE agree that Prof Piaggio's proof is not only much simpler than that given in "The Abilities of Man", but also more illuminating I agree with Prof Piaggio generally, subject to the reservation that I do not consider (3), the interpretation of g as general mental energy, to be any essential part of the theory Essential for me is that the determination of g and s leads on to that of 'group' factors, and then the varying magnitude of all three kinds of factors under varying conditions connect them up with all the laws of the human mind, as also with such influences as age, heredity, instruction Thereby, I believe, psychology is placed upon a new basis, in which the old but still prevalent 'faculties' are replaced by statistically established unitary functions I suggest that all these positive observations are at present being side tracked by undue prominence given to such speculative (however luminous) hypotheses as that of a 'general energy'

C SPEARMAN

Administration and Anthropology in India

MR CODRINGTON is unaware of the facts that in this University lectures are given every year to I C S probationers on the ethnology of India, and that an Indian area is selected for special study in the Tripos The work done by Dr Hutton and by Mr Mills is evidence that fieldwork is existent in India Nevertheless I share Mr Codrington's regret that though the facts are accessible enough to those who have cared to work them over, the present discussions at the Conference are not enhanced by anthropology

T C HODSON
(Reader in Ethnology)

University Museum of Archæology
and of Ethnology,
Downing Street, Cambridge,
Dec 15

THREE of Mr Hodson's criticisms I can answer very shortly

(1) I am well aware of the existence of the I C S probationers' courses I have expressed the opinion that considering the importance of anthropology to the embryo administrator, they are scarcely sufficient

(2) The option of selecting an Indian area in the Cambridge Anthropological Tripos is something However, I have pointed out that the district gazetteers, which must be the source books for this work, are "uncorrelated compilations", in my opinion, they are extremely difficult to handle critically, without some personal knowledge of the areas concerned

(3) With regard to my alleged neglect of Dr Hutton's and Mr Mills's magnificent work, I can only point out that I was discussing the impending carving up of India into federated units the Assamese hills are not culturally part of India proper, and from the point of view of the problem under discussion, they offer no great difficulty, because their cultural boundaries are clearly defined

The only remark of Mr Hodson's that I feel called on to reply to in detail is his assertion that "the facts [of Indian anthropology, that is, as bearing upon the creation of a federal India] are accessible enough to those who have cared to work them over". If this is so, why is there no generally accepted handbook of Indian ethnology ? Why is there no volume covering the field of India folk lore ? Why is it that no work has been done on Indian technology since the pioneer publications of Birdwood and Watt, nearly thirty years ago ? How is it that the 1 in sheets of the Survey of India are unpublished for large and important ethnic areas in India, although they are absolutely necessary for research of any kind in those areas ? Why is it that until very recently one so seldom heard Indian research matters discussed at academic gatherings ? Why is it that there are still so few specialists in Indian cultural studies ? Why is the flow of publication so sluggish ? The answer can only be that the basic data, physical and cultural, have never been provided in the necessary quantity over the necessary range, and that in default of critically conceived local studies in which the environment is taken into consideration, we have no means of manipulating the impressively massive, but uncorrelated, facts of our source books—the gazetteers

In checking the accessible literature, after any discussion of points of interest, with local observers fresh from India, one is forced to acknowledge gaps and discrepancies on all sides, and furthermore a wellnigh hopeless confusion of nomenclature The present system of recording the castes and tribes of India, upon which the monumental Census Reports, perhaps the finest of their kind in the world, are based, is an artificial system in the botanical sense Such groups of people as the Khorwa, Kapu, Vellala, Megh, and such a group as the Kurumban-Kuruba-Kurma complex which are all paraded as ethnic units in the Census Reports, are not proved entities in any scientific sense Few, if any, of them have been studied as they actually exist, in their villages and families none have been studied, even generally, over the whole of their very large areas of distribution In other words, the units have never been defined in their own environment, and we are therefore ignorant of the degree of homogeneity or variation of the alleged class

For example, there are two great castes of glass workers, nowadays mainly occupied in the manufacture of glass bangles, the Manihar and the Kachera The former have a distribution running through the Punjab, Rajputana, and the United Provinces the latter, who are much fewer in number, are confined mainly to Central India What is the real relationship, ethnical and historical, between these two professional groups, and what bearing has their modern craft upon the enormous glass bead manufacture of South India in Pallava times, of which we have just become aware ? It will be seen that this problem is the reverse of the former In many cases it is certain that unrelated groups have been lumped together under one caste title It is as certain in other cases that the same people have acquired two or more official caste names, because their distribution area straddles one or more official, political boundaries with opposing, official machinery on either side The Beda [Bedaru], Berad [Bedar] and Boya are all differentiated in the Census Reports and gazetteers, as "castes" or "tribes", but they are actually the remnants of a widely spread *nation*, numbering almost a million and a half souls, if the kindred Ramoshis of the Bombay hills and Vedars of the South are taken into consideration They are at present politically administered, as

inhabitants of various districts of the Madras and Bombay Presidencies, and of the Mysore and Hyderabad States How is this block of ethnic and traditional interests to be treated on the proposed dissection of India? By modern standards the extant literature, a few dozen scattered pages, is totally inadequate, considering the gravity of the point at issue Here are a few of the problems which I had in mind when I said that sufficient facts were not accessible to split a population of such ethnic and traditional complexity into federated units with anything approaching scientific assurance

To any Englishman the necessity of such a confession must be a bitter thing The political issue is upon us—but we may still hope for the scientific issue It is still possible to set to work, and so fill a glaring hiatus in anthropological knowledge What is urgently wanted is a series of local surveys based on lines of centres drawn along and across the most obvious cultural borders such a line as Junnar, Paithan, Ellora, Ajanta, Akot Each centre would have to be treated as a living organism, attention being paid equally to the anthropometry, sociology, verbal traditions, local cults and antiquities, the survey extending perhaps ten miles or a morning's ride from each centre As the investigation proceeds, errors in caste terminology will cancel themselves out The task is a straightforward one of simple recording, which must, however, be based on a strictly standardised technique Fortunately there is some possibility of such work being done in the near future by a party of English and Indian scholars working over a number of such groups of centres

I apologise for occupying so much space with this statement, but the situation is serious My letter was intended to express my appreciation of the leading article on "Administration and Research in India" in NATURE of Nov 22 I had no desire for controversy and I regret that I must differ from such an authority as Mr Hodson A confession of ignorance in the matter of Indian cultural studies is necessary at the moment, in order to create the possibility of regeneration The first step must be academic recognition, in the form of a chair or lectureship

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The Function of the Air Sacs of Insects

THIN WALLED expansions of the tracheæ known as air sacs occur in those insects which have well developed powers of flight Misconception as to the function of these structures is common They have been described as pumps, as reservoirs, and as balloons The first term alone seems to give an accurate description of their function, for Lee has made it clear that they must ventilate the tracheæ each air sac, when compressed, expels the air from the trachea between it and the spiracle As reservoirs the sacs could be of little use to aerial insects, for the oxygen they contain would last but a very short time during flight, while there is an unlimited supply of air only a little farther from the tissues [1,2]

The common belief that air sacs could act in the same way as the balloon or gas bag of an airship is equally untenable Packard[3] says "It is evident that the enormous powers of flight possessed by the locust, especially its faculty of sailing for many hours in the air, is due to the presence of the air sacs, *which float it up on the atmospheric sea* It will be seen that, once having taken to flight, the locust can buoy *itself* up in the air, constantly filling and refilling its internal buoys or balloons without any muscular exertion, and thus being borne along by favorable winds to its destination" Deegener[4] considers such a function possible when he says " es [das Tier] verdrängt mehr Luft und wird spezifisch leichter Ob sie [Verringerung des spezifischen Gewichtes] weit genug geht, um eine befriedigende Erklärung fur die Existenz der Luftsäcke zu geben, lässt sich somit nicht entscheiden" (See also Comstock[5]) It is not difficult to show that this decrease in specific gravity does *not* provide an explanation for their existence, and that they could not possibly buoy up the insect sensibly

Consider such an insect as the bee, and for convenience include all tracheæ capable of varying in capacity under the title of air sacs Let—

Weight of insect *in vacuo*	$= W$
Weight of insect in air	$= W_a$
Volume of insect, with sacs deflated	$= V$
Volume of expanded air sacs	$= v_a$
Volume of remainder of tracheal system	$= v_t$
Density of external air (gm per c c)	$= d$
Density of air in tracheal system	$= d_t$

According to the Principle of Archimedes, the upthrust of the air on the insect is equal to the weight of air it displaces, therefore, the weight in air of this insect with air sacs expanded is

$$W_a = W + (v_t + v_a)d_t - (V + v_a)d \qquad (1)$$

The weight of air in the tracheal system—$(v_t + v_a)d_t$—must be included in the weight of the insect, especially since it is this very air which is supposed to buoy the insect up

Suppose that the air in the tracheal system is at the same temperature and pressure as the external air, that is, $d = d_t$ When the insect has its air sacs expanded

$$\begin{aligned} W_a &= W + (v_t + v_a)d - (V + v_a)d \\ &= W + v_t d + v_a d - Vd - v_a d \\ &= W + v_t d - Vd \end{aligned} \qquad (2)$$

When the air sacs are collapsed ($v_a = 0$), (1) becomes

$$W_a = W + v_t d - Vd \qquad (3)$$

That is to say, the weights in air in the two cases are exactly the same Obviously, the weight of the air in the sacs is exactly equal to the additional upthrust due to its presence there

Suppose that the air in the tracheal system has a lower density than the external air and take the extreme case when there is a vacuum in the uncollapsed system, that is, $d_t = 0$ Then (1) becomes

$$W_a = W - (V + v_a)d \qquad (4)$$

Suppose that $v_a = V$, that is, that the volume of the insect is doubled by the expansion of the sacs—an exaggerated case Then (4) becomes

$$W_a = W - 2Vd \qquad (5)$$

If the density of the insect *in vacuo* is 0 5 gm wt per c c and of the air 0 0012 gm wt per c c, the lift of these most remarkable sacs (Vd) would be about one four hundredth part of the weight of the insect, comparable to half a pound in a man weighing fourteen stone Actually the density of the air inside the animal cannot be very different from that of the external air, and in any case it is to be expected that the pressure in the tracheæ is sometimes above and sometimes below atmospheric pressure, so that any buoyancy effect is minute indeed

The fact that the *density* of the whole insect would be reduced by the addition of air sacs does not affect the *weight* in air at all If the insect were made as big as a house by the addition of weightless air sacs filled with air of atmospheric density, the same force would still be required to lift it, though its density would be enormously reduced An

insect of this remarkable design would offer a very large surface to the winds, and wind forces would be very large compared with its weight and with the forces it could itself exert, and it would blow about like thistledown But the insects which possess air sacs are just those which rise superior to these external forces, the swift and the strong flying ones To them any increase in surface area is a disadvantage only to be borne if there is some greater advantage accompanying it This advantage, I suggest, is the increased rate at which oxygen can reach the tissues when tracheal ventilation is aided by air sacs

DONALD L GUNN

Department of Zoology,
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Dec 8

[1] Milton O Lee, *Science*, 69, 1929, p 334
[2] Milton O Lee, *Quarterly Review of Biol*, 4, 1929
[3] A S Packard, ' Zoology for Schools and Colleges , 4th edition 1883, p 344
[4] P Deegener in Schröder s ' Handbuch der Entomologie ', Jena, 1928, vol 1, p 876
[5] Comstock An Introduction to Entomology , 1925

Mirage at Cape Wrath on Dec 5, 1922

THE compiler of the Calendar of Historic Natural Events is to be congratulated on the success of his enterprise All the notes are interesting and many invite discussion It is to be hoped that they will be republished in book form with references to the original authorities

The note on the mirage seen at Cape Wrath on Dec 5, 1922 (NATURE, Nov 29, p 865), is, I suggest, one of those which will require reconsideration before it is republished In considering an observation of mirage, it is necessary to distinguish three elements what the observer saw, what the observer thought he saw, and how his observation is to be explained In this instance (NATURE, Feb 17, 1923, p 222) the lighthouse keeper at Cape Wrath was looking land wards through a telescope and observed that " a belt of the atmosphere appeared to be land and sea " It seemed to him that what he saw was a perfect representation of the whole of the coast line from Cape Wrath to Dunnet Head, " an exact replica of what would have been seen from a distance of 10 miles out at sea " It is admitted, however, that " Cape Wrath itself was rather indistinct " Bays were noticed, but nothing characteristic, like a lighthouse, is mentioned

All that is clear is that the observer saw in the sky a strip of variable width which suggested land to him, and that below this strip there was an appearance which could be taken for the sea

Now, it should be remembered that it is often exceedingly difficult to discriminate between the distant sea and the sky I have had many opportunities for observing inferior mirage at sea One sees a distant rock and its image as a single symmetrical object and sometimes it is very difficult to get rid of the im pression that the sea surface is visible right up to this object, even though one is convinced that reflection is being produced by warm air The illusion is closely akin to the illusion of water in the desert

Superior mirage is not so frequently observed, but it is to be expected that it will also be accompanied sometimes by the illusion of water where there is no water The phenomenon observed from Cape Wrath was, I believe, a case of superior mirage The reflec tion of distant hills might well have an irregular outline reminiscent of capes and bays

From the meteorological point of view this hypothesis presents no difficulty Superior mirage is ex plained as due to the total reflection of light, or rather the continuous refraction of light, at an inversion of temperature, warm air lying above cold in horizontal layers Inversions are by no means uncommon phenomena

I hope that its author will forgive me for saying that the original explanation of the Cape Wrath mirage as due to repeated reflection, light being reflected twice at vertical surfaces of separation between hot and cold air, is, to my mind, quite untenable In every observation of mirage, the angles which the incident beams of light make with the reflecting layer are very small When reflection is from air, direct reflection, such as occurs when an observer looks at the image of his own back in a pair of mirrors, is out of the question As, however, columns of hot air and cold air with a vertical boundary could not persist for a minute, there seems to be no possibility of actually testing the reflecting power of such a combination The Cape Wrath phenomenon loses in interest by being docketed in the familiar category ' superior mirage ', but that is, I fear, inevitable

F J W WHIPPLE

Kew Observatory,
Richmond, Surrey, Dec 10

Saxifrage Crosses

R O WHYTE[1] makes the statement (repeated under Research Items in NATURE of Nov 1, 1930, p 702) that the hybrid *Saxifraga potternensis* arose by doubling of the chromosomes at the semihetero typic division of the F_1 between *S rosacea* and *S granulata*

Doubling of the chromosome number may occur either during the somatic divisions or by failure of reduction These two methods have definite characteristics differentiating them in respect to seed production If the doubling takes place during mitosis, the seed production of that portion which is ' tetraploid ' will be equal to or greater than that of the derivative and following generations On the other hand, if the doubling takes place through failure of reduction, the number of seeds produced with the doubled chromosome number is a function of the number of unreduced germ cells The proportion of these is necessarily small, and they are distributed irregularly over the diploid parent plant Consequently the amount of seed produced per plant is much reduced as compared with that of the tetraploid offspring On the other hand somatic doubling gives full fertility in the *one part* affected

The following table of the seed production of the

	Seed Production of F_1 Plant	Seed Production of derivative Generations (for comparison)
DOUBLING BY FAILURE OF REDUCTION		
Raphanus Brassica[2]	45 per plant	30 per pod
Phleum pratense × *P alpinum*[3]	46 in 5 hundred thousand flowers 4 germinated	Over 400 per plant 90% germination
Digitalis purpurea × *D ambigua*[4]	200 seedlings from 2 plants	400 per capsule
DOUBLING IN THE SOMATIC TISSUES		
Nicotiana glutinosa *N tabacum*[5]	155 per fruit	?
Primula kewensis[6]	30, 90, 180 per fruit 287 germinated	122 plants per fruit
Solanum Lycopersicum[7]	20 per fruit 10 germinated	20 per fruit
Saxifraga rosacea × *S granulata*[1]	422 per fruit	85 per plant (average of 6 plants)

F_1 plant and of the derivative ' tetraploid ' generations illustrates the above fact, and indicates that *S potternensis* probably arose from an F_1 plant which

had a tetraploid number of chromosomes in a portion at least of its somatic tissue, and that it did not, as reported, arise from a semiheterotypic division of the F_1 hybrid Doubling of chromosomes in the somatic tissue is of rarer occurrence than the origin of tetraploids by failure of reduction, and *S potternensis* is an important addition to the small list of such somatically doubled forms F W SANSOME

John Innes Horticultural Institution,
Merton Park, London, S W 19,
Dec 10

[1] Whyte R O, Sterility and Flower Abnormality in the Tetraploid *Saxifraga potternensis*, *J Genet*, **23**, 1930
[2] Karpechenko, G D, The Production of Polyploid Gametes in Hybrids, *Hereditas* 9, 1927
[3] Gregor, J W, and F W Sansome, Genetics of Wild Populations, II, *J Genet*, **23**, 1930
[4] Buxton B H, and W C F Newton, Hybrids of *Digitalis ambigua* and *D purpurea*, their Fertility and Cytology *J Genet* **19**, 1928
[5] Clausen, R F, and T H Goodspeed Interspecific Hybridisation in *Nicotiana*, II A Tetraploid Glutinosa tabacum Hybrid—an Experimental Verification of Winge's Hypothesis *Genetics*, **10**, 1925
[6] Information kindly supplied by Miss C Pellew
[7] Own notes

Curling

WE have been interested in seeing the results of Prof Harrington's experiments on the motion of a curling stone on ice, published in the *Transactions of the Royal Society of Canada*, and referred to in his letter in NATURE of Sept 6, p 351, which show a considerable increase in the friction for small velocities This must produce, towards the end of a run, a couple tending to increase the spin of the stone, and no doubt explains the fact that the velocity of rotation remains nearly constant until very near the end But it has little or no bearing on what we have regarded as our main problem (see NATURE of Mar 15, 1930, p 408), namely, the production of the curvature of the path of a stone, at a time when the instantaneous centre of the motion may be at a distance of 2 feet or more from the centre of the stone, a considerable distance compared with the radius of the cup

Any difference of friction at the two sides of the stone, due to difference of velocity, must then be small But for our purpose it is not necessary to consider the magnitude of it, because it has no tendency to produce the curvature To account for the observed curvature of the path of the centre of a stone, we must find a force of sufficient magnitude in the direction of the normal to the path Resolution of the forces shows that a difference of friction at the two sides, if this is the only asymmetry apart from the spin, contributes nothing towards the production of the required force

We think that the final twist of a stone about a point of the cup, which occasionally occurs as the stone is coming to rest, may be due to regelation This satisfies the requirement of being a thing which may happen, but usually just fails to happen

W H MACAULAY

King's College, Cambridge

G E SMITH

Riverbank, Woodbridge, Dec 9

The False Killer Dolphin

ACCORDING to a note in NATURE (Dec. 6, 1930, p 892), recording the stranding of a false killer dolphin (*Pseudorca crassidens*) in Ceylon in 1929, this species is "regarded as on the verge of extinction" The same statement has appeared elsewhere, but I venture to inquire whether there is any evidence that it is correct

The false killer was originally described, as *Phocæna crassidens*, by Owen, in 1846, as the result of the examination of a skull and other bones which had been found, sub-fossil, in the Lincolnshire Fens. In 1861 a school of about a hundred individuals appeared in the Bay of Kiel In 1862 specimens, probably belonging to the same school, were stranded on the Danish islands, and were investigated by Reinhardt, who established the genus *Pseudorca* for this species About two years later a considerable number of false killers were recorded from Tasmania Skulls from this herd were sent by Mr W L Crowther, in 1864, to the Royal College of Surgeons, and other specimens were sent by the same donor to the British Museum and the University Museum of Zoology at Cambridge The species has more recently been recorded from many distant localities, including Travancore, Florida, Argentina, Lower California, and Peru In 1906 several hundred individuals were stranded in the Chatham Islands The Dornoch Firth school, October 1927, is referred to in the note published in NATURE, as well as the large herd which was stranded near Cape Town in December 1928

Most of the earlier records of the false killer as a recent species are given by Dr J R Garrood (*Proc Zool Soc*, p 177, 1924), who described the very interesting discovery of two skeletons in the Cambridgeshire Fens in 1921

Justification for the belief that *Pseudorca crassidens* is on the verge of extinction seems to be very slight, in view of the above facts Mr W R B Oliver's statement (*Proc Zool Soc*, p 577, 1922) that this dolphin "is met with in large schools in New Zealand and Tasmanian waters" is in favour of this conclusion May it not fairly be supposed that the false killer, like many other dolphins, is an inhabitant of the open sea, and that its apparent rarity is merely due to the fact that it is not often observed in the neighbourhood of the land ?

SIDNEY F HARMER

Melbourn, Cambs, Dec 12

Foaming of Beer

PERHAPS some light may be thrown on the phenomena referred to by Dr H S Rowell in his letters in NATURE of Sept 20 and Dec 13, by investigations carried out by B Shen, George King, and myself a number of years ago (*J Chem Soc*, p 1313, 1911, p 1170, 1913)

While the stability of the foam will depend mainly on surface tension and viscosity, the size of 'head' formed under the ordinary conditions of pouring out a glass of beer will depend mainly on the rate of evolution of carbon dioxide from its supersaturated solution in the beer This rate of evolution varies with the degree of supersaturation, which, in turn, depends on the nature of the beer and the method of its manufacture A pale ale, for example, was found to evolve carbon dioxide more rapidly than a stout or export beer The rate of evolution, moreover, depends greatly on the walls of the containing vessel and their effectiveness in supplying gas 'nuclei' to start the evolution of carbon dioxide

Traces of grease on the surface of the glass are very effective in promoting the escape of gas, and I think that the difference in 'head' obtained with a dry and wet glass is probably due to this fact Traces of grease are scarcely likely to be wanting from the surface of glasses dried under refreshment-room conditions In the case of a wet glass, there will be an absence of air bubbles on the surface to act as nuclei One cannot claim that the factors mentioned are adequate to account for all the phenomena, but they are probably the main factors involved

ALEX FINDLAY

Department of Chemistry,
University of Aberdeen, Dec 13

Entomology and the British Empire.

THE meeting of the Third Imperial Entomological Conference, which took place in London on June 17-27 last, has been regarded as a suitable occasion for a kind of stock-taking of what is being done towards combating insect losses in the British Empire. The Imperial Bureau (now Institute) of Entomology has done a useful service in bringing together data on this subject in an accessible and convenient form.[1] The criterion adopted is the amount of annual expenditure devoted to salaries, research, and general administration in each part of the Empire. While this method of treatment is an admirable one in many respects, it is obvious that expenditure respecting entomology incurred in one part of the Empire may not be strictly comparable with that incurred in another part: local needs, revenue, costs of living, and other factors vary so much in these respects. Due allowance needs, therefore, to be taken into account as regards differences of this nature.

When the losses due to insect depredations in the British Empire are represented in man power, we arrive at some striking conclusions. If it be admitted that 10 per cent is a conservative figure at which losses due to agricultural pests alone may be placed, it would seem that one tenth of the human effort on such a basic industry is dissipated by insect enemies. Taking the population of the Empire at about 450 millions, it may be assumed that an additional population of 45,000,000 could (if it were possible to eliminate insect pests) be supported by the same effort as that now exerted. It is estimated that in the Indian Empire, for example, the losses in 1921 due to crop and forest pests alone reached the huge total of £136,000,000, while the death-roll among the population due to insect borne diseases was stated to be about 1,600,000 persons annually. In Canada about £30,000,000 is lost every year through insect depredations among field and fruit crops and to forests. In South Africa one pest, the maize stalk borer (*Busseola fusca*), incurred losses of about £2,750,000 in a single year. Figures of this kind are, naturally, only estimates, but they serve to drive home how great these losses are. The losses to human communities by death or ill health arising from insect-borne agents of disease are most likely even greater than those occasioned to agriculture, but it would be exceedingly difficult to assess them.

A comparison of the effort made by the British Empire in coping with its entomological problems and that made by the United States is of considerable interest. The British Empire, with an estimated revenue of £1,400,000,000, devotes, in round figures, some £570,000 annually to work of this character, or 0.03 per cent of its income. There are fewer than three hundred[2] professional entomologists employed among a population which greatly exceeds 400,000,000 souls. The United States, with a population of about 106,000,000, spends an approximate sum of £2,000,000 (State and Federal allocations) annually, which works out at 0.25 per cent of its revenue of £800,000,000. It employs, moreover, not less than five hundred entomologists. The question is raised as to whether the British Empire can be justly claimed to be bearing its share in the world problems of insect control. On the basis of the United States' expenditure, that of the British Empire should be nearly six times as much as it actually is. Although insect problems in the United States are on a vast scale, they are more restricted in variety, and that country is faced with no responsibility so great as the tsetse fly problem in Africa and its immense toll of human life. The responsibility of an Empire so scattered, and concerned with so great a range of crops, peoples, and pests, would, therefore, appear to be a heavier one than that shouldered by the United States.

The varied responsibilities of the Imperial Bureau of Entomology have led to its outgrowing the original conception with which it was founded in 1913. Its recent change of title to that of "Imperial Institute of Entomology" indicates more adequately the scope of its activity and influence. The growth of its manifold activities are briefly dealt with in the Report of the Third Imperial Entomological Conference.[3] In recent years, for example, insects have been coming in at the rate of more than 5000 a month, and during the past five years very nearly 34,000 specific identifications have been issued. Despite the valuable aid given in this field by the staff of the British Museum, thousands of specimens are in hand which cannot yet be dealt with. There is urgent need for a competent dipterist on the staff: abstracting work is increasing beyond the means available and an additional preparator is required to cope with the influx of material. The rapidly increasing demands made upon the new Parasite Laboratory at Farnham Royal involve a further responsibility.

The higher salaries attached to official entomological appointments in many parts of the British Empire—but by no means all—compare favourably with those of other specialists in kindred posts. A perusal of the brochure[1] before us shows that there are two entomological posts of £2000 per annum or above; eight posts attaining a maximum salary of £1500 or above, but less than £2000 per annum; twenty-nine posts the emoluments of which attain £1000 per annum or above, but are less than £1500 per annum, and twenty six posts the maximum salaries of which range between £900 and £984 per annum.* On the headquarters staff of the Imperial Institute of Entomology, for example, there are three posts exceeding £1000 per annum, one post of £1000 per annum, and four posts rising to a maximum of £950 per annum. The salaries of entomologists attached to the Advisory and Research Services of the English Ministry of Agriculture, on the other hand, are on a markedly inferior scale. There are, at present, only three entomologists in the highest grade of the services, and their maximum salaries are attained at £830 per annum (which sum is consolidated and does not carry cost of living

* These figures do not include posts at the British Museum (Nat. Hist.) or at any English university or kindred institution.

bonus) This disparity seems even more striking when it is pointed out that the estimated mean loss by one single species of insect—the frit fly—amounts to nearly 15,000,000 bushels of oats per annum in England

At the present time, the British Empire lacks a sufficiency of young, properly trained entomologists of the right type The causes of this shortage are various, and, among them, the number of new posts established in recent years has been an important factor If developments are to progress at the same rate as hitherto, the matter of recruitment seems likely to become a problem of increasing difficulty

[1] A Summary of Data Relating to Economic Entomology in the British Empire Prepared for The Third Imperial Entomological Conference by Dr S A Neave (London The Imperial Bureau of Entomology) 2s 6d net

[2] A List of the Entomologists employed in the British Empire Prepared for The Third Imperial Entomological Conference (London The Imperial Bureau of Entomology 1930) 2s 6d

[3] Report of the Third Imperial Entomological Conference, 17th 27th June 1930 ' (London The Imperial Institute of Entomology, 1930) 2s net

Cancer Research.

SEVERAL of the papers in the Ninth Scientific Report on the Investigations of the Imperial Cancer Research Fund (London Taylor and Francis, 1930 20s) deal with the fowl tumours which can be transmitted from bird to bird by tumour extracts filtered through filters so fine that the infective filtrate contains nothing large enough to be clearly visible under the highest powers of the microscope The nature of this 'agent' is the most crucial question of current theoretical cancer research It may, on one hand, be analogous to the invisible viruses which are associated with so many infectious diseases in animals and plants, it may, on the other hand, be a special example of the chemical substances arising from the disintegration or injury of cells which promote tissue growth The 'agent' by which transmission is effected may, in short, arise in the cancer cell or may come into the body from outside

The solution of this problem is, too, of more general importance, for the answer, whichever it is, cannot fail to influence our opinions as to the essential nature of the infectious viruses and the bacteriophage So far, these 'filterable' tumours are known only in birds Dr J A Murray and Dr A M Begg give careful descriptions of two, one is judged to be an endothelioma, the other is a slow growing fibro sarcoma Both appear to be quite different structurally from the well known Rous tumour, though it does not seem to be quite impossible that all are phases of the same kind of tumour Dr W Cramer has reinvestigated the possibility of transmitting rat and mouse tumours by tissue which had been repeatedly frozen and thawed, and in which all the cells were presumably and, so far as could be ascertained by tissue cultures, actually dead With carcinoma the inoculations were uniformly negative, some of the sarcoma preparations gave rise to fresh tumours and rapidly lost their infectivity on incubation or washing In another paper Dr Cramer and Mr H G Crabtree point out that positive results are not always obtained with frozen preparations of the Rous tumour, which is generally regarded as the typical filterable bird tumour The results, therefore, do not show conclusively that mammalian tumours can be transmitted from one animal to another without the intervention of living cells, but they certainly suggest that from some such tumours evidence may be obtained of a labile 'agent' similar to the 'agent' of the bird tumours

Three other papers, by Mr H G Crabtree, follow out the work of Warburg on tissue respiration The most interesting discovery is that the epithelial overgrowths of fowl-pox and vaccinia have an active metabolism of the type which has been supposed to be characteristic of malignant tumours This makes it more unlikely even than before that any alteration in cellular metabolism can be the cause of cancer

Dr R J Ludford discusses critically another theory of the origin of cancer, which supposes that malignancy may be due to chromosomal mutations in somatic cells—an idea specially associated with Boveri It is truly a remarkable fact that tumours practically always breed true that is, though a tumour may have little structural resemblance to the tissue from which it arises, it maintains a characteristic structure of its own throughout its history, which with some animal tumours is now a very long one, involving large numbers of animals It is also true that various irregularities in mitosis and in the chromosomes are found in malignant tumours But beyond these two facts there is really nothing to indicate somatic mutations as the basis of malignancy, and it is difficult to see how more conclusive evidence could be obtained

It is the fundamental property of malignant tumours that they are functionally isolated from the rest of the body and take no part in the coordinated activities of its various organs and tissues they live for themselves alone Hence they would not be expected to have either blood vessels or nerves of their own It has been stated from time to time that this generalisation is not universally applicable, and that nerves, for example, are sometimes present Dr Ludford has carefully worked over the matter in a number of mouse tumours and cannot assure himself that tumours cells are ever innervated the nerves sometimes found in the substance of tumours have probably been accidentally incorporated in the new growth in the course of its invasion of normal tissue

Dr J A Murray and Dr L Foulds have examined in various ways the proposition that the development of one tumour in an animal tends to inhibit the appearance of another, and Dr Cramer discusses another aspect of the same problem There is no doubt some immunity, partly general and partly local, but attempts to define the facts more precisely appear to meet with the most embarrassing vagaries of experimental results There must be some key point in the matter which has not yet been identified

Obituary

THE RIGHT HON LORD MELCHETT, P C, F R S

ALFRED MORITZ MOND was born on Oct 23, 1868, at Farnworth, in Lancashire, within smell of the famous alkali works His father, Dr Ludwig Mond, was at that time a chemist at the Hutchinson Alkali Works, it was not until five years later that he founded the firm of Brunner Mond in partnership with John Brunner, an accountant at Hutchinson's Mrs Ludwig Mond has described to me the Farnworth days as very happy ones--they preceded some very strenuous times at Winnington

Alfred Mond in his lifetime had thus seen the founding of the B M Works, as it is familiarly called in the north of England, the overcoming by strenuous effort of its early difficulties, both technical and financial, its growth to become the most important chemical firm in Britain, and its disappearance as an entity on absorption into Imperial Chemical Industries, Ltd Although he was associated closely with the management of the firm in early days, after the retirement to London and death of Ludwig Mond the active management at Winnington passed into the hands of Sir John Brunner and his two sons, and Alfred Mond's energies were largely spent in other directions

Educated at Cheltenham and the Universities of Cambridge and Edinburgh, he was called to the Bar via the Inner Temple and practised for a time on the North Wales and Cheshire Circuit before entering the family business at Winnington Ludwig Mond had interested himself in two other chemical ventures, one a process of refining nickel by means of the carbonyl it forms with carbon monoxide, and the other the well known Mond gas producer Both required skilled handling to carry them to practical and commercial success, and as the Brunners stood aside from them, this work fell on Alfred and his brother Robert and cousin Emil

By 1906 Alfred Mond found time to enter politics, and was elected for Chester as Liberal member in that year For some years politics more and more engaged his attention, and it was not until about 1925 that he seriously returned to the chemical industry, becoming chairman of Brunner Mond at a moment of internal crisis and throwing himself in characteristic manner whole-heartedly into its management Imbued with an intimate knowledge of world conditions and grasping the totally different state of affairs which the War had brought about in industry both at home and abroad, he set himself to bring about what is now known as rationalisation in the businesses in which he had authority The three great combines, Imperial Chemical Industries, Amalgamated Anthracite Collieries, and International Nickel, have resulted from his efforts, and their bigness and the courage displayed in their creation have made Mond's name known throughout the world All are too young as yet to have proved the wisdom of such rationalisation, but at least it is known to the scientific world that Alfred Mond's leadership involved recognition of the value and the utility of science in industry to an extent hitherto quite unknown in Great Britain

Imperial Chemical Industries from the first has set out to foster and encourage the development of schools of research at the universities, so that I C I might always find an adequate supply of highly-trained chemists available, it has bettered the conditions of employment of chemists at its works and brought into being at its individual factories research staffs of a magnitude and a capacity equal to that of any organisation in the world If what we believe of the powers of the scientific worker in industry is true, no better means could have been taken to ensure from the outset the prosperity of Britain's greatest manufacturing concern In Mond's own words, " my belief is that the chemist will solve the present economic and industrial problems of the world "

To understand Mond himself, one must know something of the altogether exceptional characters of his father, a scientific worker and an inventor first and last, and of his mother, a woman of unique artistic charm and vivacity and surprising brilliance of intellect He thus inherited a feeling for science and an appreciation for art which have at times prevailed over those qualities, requisite for a successful politician of the fighting type and an industrialist and financial magnate of the first order, by which the world knew and judged him and with which he was so richly endowed

As a consequence Mond was highly flattered by his election to the Royal Society, and he welcomed with pride the honorary degrees bestowed on him by St Andrews and Manchester, he took active interest in a number of scientific societies even when at his busiest in other ways, becoming, for example, founder president of the Institute of Fuel, president of the British Science Guild, and was designated president of the Society of Chemical Industry for its jubilee meeting this year, besides being always ready to lecture or otherwise help scientific institutions

In industry on the technical side, Mond had the widest possible views and great courage, he was able to grasp immediately the merits, demerits, and potentialities of the schemes put before him and, once satisfied, to ensure that they were immediately given practical effect Until recently it was as a politician that England knew him best, and no man has gone further in politics under greater personal handicaps Latterly it is as a politician, a leader of industry and an Empire builder combined in one man that he has won notoriety and fame He had the gift of going to the root of any question, grasping the realities and unmasking the shams—his extraordinary power of quick thinking enabled him to see round the corner of the problems of the day Underlying most of his public utterances it is possible to discern the spirit of science, and it is for the electors of the future to see that more men of his type represent them in Parliament Alfred Mond made use to the utmost of those gifts which he acquired by heredity

and by training, and his boundless energy enabled him to attain the very top in every field of endeavour he has passed away at the very height of his career His death on Dec 27 last is a loss that science as well as Great Britain can ill afford

E F ARMSTRONG

SIR FRANCIS OGILVIE, C B

SIR FRANCIS GRANT OGILVIE, who died suddenly at Edinburgh on Dec 14, at the age of seventy-two years, came of a family which had long been honourably associated with scholastic and scientific occupation He graduated M A at Aberdeen and B Sc at Edinburgh, and in 1886 was appointed Principal of the Heriot-Watt College, Edinburgh In 1900, he became Director of the Royal Scottish Museum of Science and Art at Edinburgh, and thus began that activity in museum administration which occupied the greater part of his working life

Three years later Ogilvie was appointed Principal Assistant Secretary for Technology and Higher Education in Science and Art at the Board of Education, and there began that close connexion with the museums and scientific institutions at South Kensington which continued for many years At that time, in his position under the Board of Education, matters relating to the Victoria and Albert Museum (by which title the South Kensington Museum had been known since 1898), the Royal College of Science, and the Royal School of Mines came before him, and consequently, when the scheme for forming the Imperial College of Science and Technology from the Royal College of Science, the Royal School of Mines, and the City and Guilds Engineering College was under consideration, the working out of the details and the drafting of proposals mainly fell to him to carry out

By 1908 the art collections of the old South Kensington Museum were safely housed in the new buildings of the Victoria and Albert Museum, but those illustrating science and engineering still remained in a part of the buildings which had originally been constructed for the Exhibition of 1862 On the initiative of Sir Henry Roscoe an influential and representative body of scientific men and leaders of industry brought to the notice of the Government the urgent need of adequate accommodation for these collections, and for their active development, with the result that in 1910 a Departmental Committee, under the chairmanship of Sir Hugh Bell, was appointed by the President of the Board of Education to consider and report upon the Science Museum and the Museum of Geology in Jermyn Street, Ogilvie being the secretary of the Committee In this capacity he got together the evidence for the Committee, and its report, which was published in 1911, set forth clearly the lines on which the Science Museum might advantageously be developed, and on which it has in fact been developed since then, although the War delayed this until he had ceased to be Director

On the death of Mr W Last in 1911, Ogilvie was appointed Director of the Science Museum, retaining also a certain administrative supervision of the Geological Museum and Survey, but the War put a stop to the construction of the new Museum buildings which the Committee had recommended and to the development which they had approved He then became Assistant Controller of the Trench Warfare Department and then later of the Chemical Warfare Department at the Ministry of Munitions, so that his reorganisation of the Museum had to be postponed Shortly after the conclusion of peace he became Principal Assistant Secretary to the Department of Scientific and Industrial Research from 1920 until 1922, when he retired

During his twenty years' work Ogilvie had acquired an unrivalled knowledge of all that had taken place in the course of the establishment and development of the various scientific and educational institutions which had grown up at South Kensington, and this was of great value to the governing bodies of many of them on which he served, namely, as a governor of the Imperial College of Science and Technology, as a commissioner of the Exhibition of 1851, and as a member of the Senate of the University of London

He was also the president of the Museums Association in 1927–28, and gave valuable evidence before the Royal Commission on National Museums and Galleries He held the chairmanship of the Geological Survey Board from 1920 until last year

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PROF FRANTIŠEK WALD

THE prominent Czech chemist, Prof František (Franz) Wald, formerly professor of physicochemistry and metallurgy in the Czech Polytechnic High School of Prague, died on Oct 19 in Moravská Ostrava-Vítkovice, the well-known ironworks He was born in Brandýsek, near Kladno, and after studying in the German Polytechnic High School of Prague, whence he brought no theoretical bias, he devoted himself to technical chemistry, being for many years chief of the analytical and research laboratory of the ironworks in Kladno

While there, Wald published several interesting papers on the philosophical points of theoretical chemistry, especially "Die Energie und ihre Entwertung" (1889) Other of his important papers on thermodynamics were published in the *Listy Chemické* and in the *Zeitschrift für physikalische Chemie* His paper on the fundamental chemical ideas was read at the Philosophical Congress in Paris (1900), and was reprinted, together with his other papers, in Ostwald's *Annalen der Naturphilosophie* Owing to the originality and depth of his ideas, Wald was nominated in 1908 ordinary professor in the Czech Polytechnic High School, in which he was active up to the year 1927

Space does not permit me to give all the titles of Wald's philosophical publications, and it is also impossible to give a short account of his ideas, which were very original and therefore very different from what the great majority of chemists regard

as the fundamental notions of our science First of all, Wald was an 'anti-atomist', and so Ostwald, who was at that time (1901) 'anti-atomist' himself, included him in his well-known series of "great men of science" The doctrine of Wald is purely phenomenalistic, that is, it is devoid of any hypothesis concerning the reality of processes which would explain observed phenomena He worked out a theory of chemical stoichiometry based on the empirical laws of constant proportions, and, accepting the part that the composition of substances varies discontinuously, he was able to deduce the law of multiple proportions In his deductions Wald disregarded the difference between simple and compound bodies (that is, our elements and compounds), a chemical unit of water being, in its interior, just as homogeneous as is that of hydrogen or oxygen My objections, brought forward in a special meeting and based on the specific heats of gases and liquids, were disregarded by him, all 'bodies' were merely 'pure phases' to him, and he was original in explaining them by the use of the first up to the fifth dimension—of course, as said above, without the use of the atomic theory

Wald also enlarged Gibbs's ideas of phases, and deduced a modified phase rule in a simple and original manner To the question *cui bono?* the practical side of scientific chemistry will give no answer, but from the point of view of chemical philosophy his ideas may be regarded as splendid, something analogous to the views of the great philosopher Heraclitus, and they really both require 'a good swimmer'

BOHUSLAV BRAUNER

WE regret to announce the following deaths

Prof A A T Brachet, For Mem R S, Rector of the University of Brussels and director of the Laboratory of Embryology of the Faculty of Medicine in the University, aged sixty-one years

Major E A FitzGerald, author of "Climbs in the New Zealand Alps" and "The Highest Andes", on Jan 2, aged fifty nine years

Prof Hans Kniep, director of the Institute of Plant Physiology at Berlin Dahlem, on Nov 17, aged forty-nine years

Mr H A Lowe, honorary fellow of the Textile Institute, who discovered in 1899 the process of 'tensioning' mercerised cotton fibre, on Dec 26

Prof S G Navashin, of the Botanic Garden, Tiflis, Georgia, who was a foreign member of the Linnean Society of London, on Dec 10, aged seventy three years

Prof T Wibberley, formerly Harrington professor of agricultural research, University College, Cork, who was known for his work on the breeding and introduction of new varieties of oats and wheat, on Dec 22, aged fifty years

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News and Views

THE New Year's Honours List contains the names of the following men of science and others associated with scientific work *Baron* Sir Ernest Rutherford, chairman of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research, and until recently president of the Royal Society *Baronets* Sir John Rose Bradford, president of the Royal College of Physicians, Sir Richard Gregory, editor of NATURE *K C B* Dr F E Smith, secretary to the Committee of the Privy Council for Scientific and Industrial Research *K C M G* Hon Sir Walter Hartwell James, Chancellor of the University of Western Australia, Dr A W Hill, Director of the Royal Botanic Gardens, Kew *Knights* Prof C R Beazley, professor of medieval and modern history in the University of Birmingham, Mr W W Hornell, Vice Chancellor of Hong Kong University, Dr E G Graham Little, member of Senate of the University of London since 1906, Dr R W Livingstone, Vice-Chancellor of the Queen's University, Belfast *C B* Mr R L Hobson, Keeper of Ceramics and Ethnography, British Museum *C I E* Lieut Col H W Acton, director of the School of Tropical Medicine and Hygiene, Calcutta *C B E* Miss Caroline Haslett, director of the Electrical Association for Women and secretary of the Women's Engineering Society (Inc), Miss Edith Helen Major, Mistress of Girton College, Cambridge, Miss Louisa Martindale, president of the Medical Women's Federation and vice-president of the Medical Women's International Association, Prof Sidney Russ, professor of physics, Medical School, Middlesex Hospital, for work in connexion with radium, Mr J J Shaw, secretary to the Seismological Investigations Committee of the British Association *O B E* Dr W M Aders, lately economic biologist, Zanzibar, Mr R S Capon, Superintendent of Scientific Research, Royal Aircraft Establishment, Air Ministry, Mr J M Carey, H M Divisional Inspector of Mines, Mr J S Corbett, secretary of the Empire Forestry Association, Mr A de V Wade, principal assistant in the Native Affairs Department, Kenya *M B E* Dr V E Wilkins, Assistant Principal, Ministry of Agriculture and Fisheries

THE inclusion of the name of Sir Ernest Rutherford confers on the New Year's Honours List a quite unusual distinction One of the earliest of the distinguished band of research students who were attracted to Cambridge by the discoveries of Sir J J Thomson, he rapidly made his mark on physics Incidentally he was one of the earlier workers in wireless telegraphy, but it is with the science of radioactivity that his name has become inseparably linked Not only was he the first to recognise the complex nature of the radiations given out by radioactive substances, but he was also the first to unravel the knotty problems presented by the decay curves of these substances, and to enunciate the simple laws governing their disintegration In a few years he covered this field so completely that little was left for subsequent research save the filling in of details and the adjustment of a few constants If the value of a scientific theory is to be judged by its fertility, Rutherford's publication of his nuclear theory of the

atom must be regarded as one of the greater landmarks of science The conception of the atom as a miniature solar system having a central massive positively charged sun around which the electrons circulate like planets, was a bold one, as it had been demonstrated beyond doubt that a system of this type must be unstable on the generally accepted laws of electro dynamics

BY simple but cogent arguments, however, Rutherford succeeded in demonstrating that the planetary structure of the atom was the only one consistent with experiment, and a whole mass of unexplained and apparently unconnected observations crystallised into coherence around the new idea The theoretical work of Bohr and his successors, and the consequent rise of the new spectroscopy, were the natural and inevitable outcome of this new conception of the atom Leaving the problem of the arrangement of the electronic satellites to others, Sir Ernest has more recently launched a mass attack on the problem of the structure of the nucleus itself The difficulties in the way of determining the structure of a particle so minute that a million million of them could lie along a line a centimetre or so long are sufficiently obvious, but so skilfully has Sir Ernest directed the attack that a solution of the problem may be confidently expected in the very near future It is announced that Sir Ernest is taking the title of Lord Rutherford, and scientific workers everywhere will wish him health and long life to enjoy the title which he adorns

THE connexion of holders of the highest office in the Royal Society with the peerage of Great Britain provides some interesting reminiscences The Society began its presidency, in fact (after incorporation on July 15, 1662), with a peer of the realm, namely, Viscount Brouncker, who held office from April 1663 until Nov 30, 1677 He was a mathematician—the first to introduce continued fractions Huygens, in a letter to Oldenburg, congratulated the Society on having so eminent a mathematician for its president as Lord Brouncker, and Sprat the historian, his contemporary, says, "This office was annually renewed to him by election, out of the true judgment which the Society made of his great abilities in all natural and especially mathematical knowledge" From Nov 30, 1686, until the anniversary meeting of 1689, the Earl of Carbery was president He succeeded Pepys, and in the year following the death of Charles II, the founder Another peer was then chosen—the Earl of Pembroke, but his tenure lasted one year only He was three times married, too much occupied apparently to give attention to the Society, for his name does not appear as presiding, on any one occasion, at the council or ordinary meetings After two commoners had occupied the chair (Evelyn had twice declined), John, Lord Somers, Lord Chancellor, was unanimously elected president, the mantle devolving, moreover, on a bachelor A great and powerful figure, he filled the chair for ten years, presiding regularly over the council and meetings

LORD SOMERS resigned the presidency of the Royal Society to Sir Isaac Newton, who was followed by two other commoners, Sloane and Folkes The latter was succeeded in 1753 by the Earl of Macclesfield, who held office for twelve years He was mainly instrumental in procuring the change of style in 1752 His interests lay in astronomy and chemistry Altogether Lord Macclesfield was a brilliant personality in the Society's affairs, and, by the way, an upholder of pomp and ceremony He died in office on Mar 17, 1764 The Earl of Morton succeeded him, a distinguished patron of science In 1746 he had visited France and was for a time imprisoned in the Bastille Like the former president, he died in office, on Oct 12, 1768 Following the foregoing particular social attachments, seven commoners were successively elected presidents of the Royal Society, down to 1830, when the Duke of Sussex assumed the chair Afterwards, in order, were the Marquess of Northampton, the Earl of Rosse, and Lord Wrottesley Reverting to previous practice, eight commoners were in turn elected, all highly distinguished in various departments of science The eighth, Sir William Thomson, elected Nov 30, 1890, was made a peer (Lord Kelvin) whilst in office He was succeeded by Sir Joseph Lister, who was raised to the peerage (1897) whilst president of the Royal Society A commoner then took office (Huggins), and he was succeeded in the presidency by John William Strutt, Lord Rayleigh, who served from Nov 30, 1905, until Nov 30, 1908 Since that date no president has been raised to the peerage during his term of office

MAJOR A G CHURCH's action in voting against the Government in the division on the Dyestuffs Act has resulted in his resignation of his office as Parliamentary Private Secretary to Mr Tom Shaw, Secretary of State for War In a statement to the Press following his resignation, Major Church said that Great Britain is more dependent on the progress of science and the application of science to industry than any other country, and that prominent members of the Government have done service to this dependence in their public utterances Nevertheless, although most of the professional scientific bodies in the country, including the Association of Scientific Workers, of which he was general secretary, have expressed the opinion that the Dyestuffs Act should not be allowed to lapse until after the fullest inquiry has been made into the possible effects of any such course on the progress of the dyestuffs and allied industries and on organic chemical research, and although the experts in the Government Defence Services advocated the continuance of the Act, the Government decided to allow it to lapse, ostensibly in the interests of the textile trades This decision was reached without consultation with the representative scientific bodies concerned, and the Government did not even take the obvious course of referring the matter either to its own Advisory Council for Scientific and Industrial Research, or its Economic Advisory Council, or the Medical Research Council, or the Committee of Civil Research, in other words, the Government paid no regard to scientific opinion Major Church contrasted the Government's attitude towards scientific workers with its attitude towards the executive of the Miners'

Federation and the coal owners before and during the passage of the Coal Bill, and towards local education authorities, the teachers' organisations, and the religious bodies over the Education Bill Apparently, he said, in spite of the incalculable value of the work of men of science and the effect of science on the body politic, the Government felt they could be ignored because numerically they are insignificant and presumably their political influence negligible He voted against the Government deliberately in order to focus attention upon what he regarded as a grave fault of Government

FRIENDS of Dr C E P Brooks will be glad to hear of the award to him of the Buchan Prize of the Royal Meteorological Society in recognition of his numerous researches in the field of meteorology and climatology Dr Brooks is distinguished as the author of a large number of papers contributed to the *Quarterly Journal of the Royal Meteorological Society* and to the *Meteorological Magazine*, a number of official memoirs issued by the Meteorological Office, as well as of several books These works embrace such topics as the distribution of the weather elements in different parts of the globe and their correlation, sunspots and lake levels, forests and rainfall, weather periodicities, and British floods and droughts, with a large amount of statistical material invaluable to students of climate But Dr Brooks's most important scientific work is in the field of palæo climatology, wherein he has enlarged our ideas greatly, and in this field his book published a few years ago on "Climate through the Ages" occupies a prominent place in the very wide literature on the subject It is obvious that certainty about the past climates of this planet cannot be reached, but probability can, and it is not too much to say that Dr Brooks has given us a good indication not only of the major phases of climate which the earth has gone through in the geological past but also the minor phases that have preceded the present phase in our own islands Dr Brooks's cardinal principle that redistributions of land and water are quite capable of bringing about the changes of climate that are inferred to have taken place has been criticised, but it is probable that most climatologists will support this principle, particularly in cases where accumulations of ice and snow enter to complicate the situation Of the formidable power possessed by ice and snow to engender further cold Dr Brooks himself has provided a mathematical demonstration

THE Melchett Medal of the Institute of Fuel, for the year 1930, the first to be awarded, will be presented to Dr Kurt Rummel, of the Wärmestelle, Dusseldorf, at the Institution of Civil Engineers, Great George Street, Westminster, S W 1, on Friday evening, Jan 23, at 6 30 The Melchett Medal was instituted by the founder-president, the late Lord Melchett, who offered the Institute a few months ago a sum of money sufficient to found the medal in perpetuity It is to be awarded annually, "to such person, whether a member of the Institute of Fuel or otherwise, as in the opinion of the Council has done either original research, or professional, administrative, or constructive work of an outstanding character, involving the scientific preparation or use of fuel, provided the results of such work have been made available within recent date for the benefit of the community" Dr Rummel was born on July 1, 1878, at Aschaffenburg, Bavaria In 1919, he took charge of the Wärmestelle, Dusseldorf, of the Verein Deutscher Eisenhuttenleute At that period the contraction of the German coke producing areas under the terms of the Treaty of Versailles and the diminishing tonnage in the German mines in the producing areas led to a great scarcity of fuel for industrial purposes, and the Wärmestelle was formed primarily for improving fuel economy in iron and steel practice Much of the work of the Warmestelle, done under Dr Rummel's guidance, is of fundamental importance, and a wide range of papers embracing investigations dealing with problems relating to coke oven technology, blast furnace, open hearth, and rolling mill practice has been published Members of all scientific and technical societies are cordially invited to attend the presentation and lecture

THE ability of the electric arc to reproduce speech when the current from a telephone transmitter is superimposed upon it was demonstrated many years ago, and this peculiar form of loud speaker is well known as the 'speaking arc' On Jan 2, Mr J L Baird demonstrated to a representative of NATURE that under proper conditions the arc can be made to follow the normal rapid modulations of television A small arc lamp, upon which the television current had been superimposed, was placed behind an aperture in a diaphragm, the light from the arc being concentrated on the aperture by means of a lens A second lens was adjusted between the aperture and a revolving Weiller mirror drum with thirty mirrors, the lens and drum being arranged so that an image of the aperture traverses a screen of white board, forming a television image, the image being transmitted from the standard Baird transmitter used in the B B C daily transmissions The detail and definition of the received image were comparable to that received on the standard commercial television receiver, and the brilliance of illumination was remarkable This demonstration of the successful modulation of the arc with television signals appears to open up considerable possibilities The chief difficulty met with in the projection of television images on large screens has been the obtaining of a modulated light source of sufficient brilliancy Two methods have been used the neon tube and the Kerr cell The brilliance of the neon tube is not great, the Kerr cell gives more brilliant results, but it also has definite limitations With the Kerr cell system, light from a powerful arc lamp is passed through two Nicol prisms, between which is a vessel containing two adjacent electrodes immersed in nitro benzene The television signals are impressed upon the electrodes and vary the plane of polarisation, and thus the amount of light passing The efficiency of this device is very small, 50 per cent of the light is lost through polarisation, and

further losses are entailed in passing through the prisms By modulating the light of the arc directly, these losses are obviated, and the television arc would therefore appear to have a useful future

A PHYSICAL conception of the end of the world formed the basis of the presidential address delivered by Sir Arthur Eddington on Jan 5 before the Mathematical Association at the London Day Training College The world, or space time as Sir Arthur Eddington called it, was shown to be a four dimensional continuum, thus offering a choice of many directions to take in order to look for the end From a space dimensional point of view the world is spherical, but then the time dimension must be considered too This consideration formed the basis of the lecture Entropy, that is, the measure of the disorganisation of a system, was suggested by Sir Arthur as being the fundamental theme upon which to work Despite the phenomenon of evolution, whereby all types of systems have become and are still growing more highly organised, there is, on the whole, a general loss of organisation Such ever increasing organisation will perforce swallow up finally the organisation due to evolution Sir Arthur Eddington emphasised this conception, showing that finally the whole universe will reach a state of complete disorganisation, a uniform mass in thermodynamic equilibrium This would be the end of the world He considered finally what such an end would be like, but, realising that the doctrine of spherical space and the results connected with the expansion of the universe have become modified he merely made one of several possible suggestions Taking the widely supported hypothesis that matter slowly changes into radiation, he suggested that the world will finally become a ball of radiation, growing ever larger, with the radiation becoming thinner and assuming longer wave lengths About every 1,500,000,000 years the radius would be doubled, and this increase would carry on in geometrical progression

ACCORDING to an announcement in the *Times* of Dec 31, the collection of antiquities from the Roman Wall, formed by the well known Northumbrian antiquarian, John Clayton of Chesters (1792–1890), has been conveyed to a body of trustees for permanent preservation in Northumberland The collection will continue to be housed in the building erected for it in 1896 by Mr G N Clayton, subject to the goodwill of the present owner of the Chesters estate, Mr John Maurice Clayton, the donor to the National Trust of the fort of Borovicus (Housesteads), to whose generosity the present gift to the nation is due The first body of trustees includes Sir George Macdonald, Mr Robert Holland Martin, Mr R G Collingwood, Mr R Carr Bosanquet, and Mr Parker Brewis The collection is well known to archæologists as the finest assemblage of Romano British antiquities in the north of England and a most important source of information for the history of the Roman occupation of Britain It includes a large variety of objects in bronze, pottery, and other materials, as well as more than 300 inscribed or sculptured stones The famous "Chesters Diploma", a diploma of military discharge and citizenship on two fragments of bronze tablets, presented to the British Museum by Mr Clayton, is represented by a replica A statue of Cybele, a bas relief of the war-god, Mars Thingsus, and inscribed altars dedicated to Jupiter, Apollo, Mars, Cocidius, Antocidius, Vitiris, Huitris, Fortuna, and Minerva are noteworthy objects forming part of the collection

THE collection of objects at Chesters, from the Well of Coventina, 3½ miles distant, is of considerable interest to students of early British culture These include a sculptured stone stele dedicated to her by Titus Domitius Cosconianus, prefect of the first cohort of Batavians, another stele on which the goddess is represented with two attendant nymphs holding vessels from which pour streams of water, numerous altars dedicated to her and other deities, bronze brooches, bronze figures of a horse and a dog, and more than thirteen thousand coins which had been given as votive offerings at the well Coventina was evidently a water-goddess whose cult, judging from the number of offerings, must have been of considerable importance The writer in the *Times* cites Sequana upon the Seine and Damona at Bourbonne les Bains as similar cults of local water goddesses, but as their names indicate, these, like Coventina, were Celtic in origin The local cult of the water goddess was a characteristic feature of early Celtic religion and traces of such cults are to be found in many parts of Britain A noteworthy example was situated near Bath It is usually to be found, however that these goddesses have suffered a transformation, first into a god and then into a Christian saint, who becomes the patron of the spring or well, at which votive offerings have been made throughout the ages down to modern times

FOLLOWING its usual practice, the *Engineer* devotes a great part of its first issue of the year to a review of the technical progress which has taken place during the past twelve months in naval construction, electrical engineering, steamships and motorships, aeronautics, hydro electric engineering, and bridges Noting that seventy five years have passed since the *Engineer* was founded, it is remarked "As we glance back over the long period of our existence, we are unable to discover any year which resembles that which has just ended", and "we do not believe that in the whole history of the mechanical engineering and metal trades any parallel can be found for the conditions which now prevail" Admitting that for these conditions there is no single obvious cause, and that the complaint is practically world wide, the article touches upon matters affecting the industries of Great Britain, such as the attempt to maintain a higher standard of living than is perhaps justified, the possible effects of fiscal policies, and taxation, which is twice as high as in Germany, two and a half times as high as in Belgium, four times as high as in Italy, and twice as high as in the United States

THOUGH 1930 was not a fruitful year in the industrial field either at home or abroad, it holds to its

credit the completion of a few great civil engineering works, notably the closing of the arch of the great Sydney Harbour Bridge This bridge has a steel arch of 1650 ft span The Kill Van Kull Bridge between New Jersey and Staten Island is of the same type but with a span of 1652 ft An examination of the two bridges and the methods of erection show many differing features Another fine bridge is the *Montreal Harbour Bridge over the St Lawrence* River, the main span of which is a symmetrical cantilever having a length of 1097 ft from centre to centre of the main piers Good progress has been made with the Hudson River Bridge at Manhattan, New York, the steel wire cables of which have a total strength of 350,000 tons The span from the centres of the cable supporting towers is 3500 ft, and the total weight of the suspended superstructure will be no less than 90,000 tons When completed, the bridge will have two decks, the upper deck giving accommodation for eight lines of roadway traffic and two footways, while on the lower deck there will be two sets of two railway tracks Another bridge completed during 1930 but of an entirely different and very striking character was the ferro concrete arch bridge over the river Elorn at Plougastel, near Brest, the bridge having three main spans, each of which is 611½ ft from centre to centre

THE La Brea asphalt pits, not far from Los Angeles in California, have gained world wide fame on account of the extraordinary number of remains of sabre toothed tigers and other mammals which have been found embedded in them The census of skeletons of birds, just completed by Dr Hildegarde Howard, is scarcely less imposing From Science Service, Washington, D C, we learn that of more than 4100 birds recovered, 69 per cent are predatory species, and of these, diurnal birds of prey (2500) far exceed nocturnal forms (400)—evidence, similar to that yielded by the mammals, that most of the creatures caught in the glaur were in pursuit of others seen to be in difficulties Some extinct forms are in large numbers 500 individuals of the turkey, *Parapavo*, more than a hundred of *Teratornis*, a vulture larger than any flying bird of the present day, as well as numerous smaller extinct vultures The caracara, now confined to more southerly regions, is represented by 250 examples Many species still existing in California occur profusely—the American golden eagle with more than 880 individuals, the California condor 190, the bald eagle 150, the red-tailed hawk 113, great horned owl 104 Ducks and geese are fewer, in all less than 100, waders less than 60, two species of stork (one extinct, the other now a southern form), 28 individuals, 30 cranes, 8 herons, 2 ibises, and one grebe

THE annual report for 1929 of the Rockefeller Foundation, New York, recently issued, covers the first year of operations of the new Rockefeller Foundation, which, as foreshadowed in the report for 1928, is now constituted by the merging of the Rockefeller Foundation and the Laura Spelman Rockefeller Memorial into the new corporation The activities of the Foundation, formerly limited to the domain of international public health, have been extended and now include, in addition, the advancement of knowledge in the medical sciences, the natural sciences, the social sciences, and the humanities In the international health division, the work on malaria and hookworm disease prevention and investigations on yellow fever have been continued In the medical sciences, aid has been given to institutions, including the University of Oxford and St Bartholomew's and the London Hospitals, and to nursing institutions In the natural sciences, aid has been given to various biological institutes and for the support of *Biological Abstracts*, and a grant made to Prof Michelson for a re determination of the velocity of light In the humanities, the British Museum is to receive aid towards the publication of a new Catalogue of Printed Books

PROF G ELLIOT SMITH, who has just returned from a visit to China, will deliver a public lecture, with lantern slide illustrations, on Peking man, at 5 30 on Jan 15, at University College, London, W C 1

DR HERBERT LEVINSTEIN, chairman of council and past president of the Society of Chemical Industry, formerly managing director of British Dyestuffs Corporation, Ltd, has been awarded the Society's medal for 1931 The medal was awarded chiefly for his capable and valuable work in the dyestuff industry

AT the meeting of the London Mathematical Society on Thursday, Feb 5, at 5 P M, at Burlington House, London, W 1, Prof G N Watson will deliver a lecture on "Ramanujan's Note Books" Members of other scientific societies who may be interested are invited to attend

AN earthquake of moderate intensity was recorded at Kew Observatory at 10 h 1 m 44 s G M T on Jan 2 According to a message broadcast by the United States Coast and Geodetic Survey, the shock occurred near lat 18° N, long 108° W, under the Pacific Ocean about 300 miles from the Mexican coast The Kew observation agrees with this

IT is announced in the *British Medical Journal* that the Dr Sophie A Nordhoff Jung Cancer Prize for the best work of recent years in the field of cancer research has been awarded to Dr Alexis Carrel, of the Rockefeller Institute for Medical Research in New York, for his development of the method of tissue cultivation and his application of it in the solution of the basic problems of pathological growths, especially the growth of malignant tumours The commission of award was composed of Profs Borst, Döderlein, von Romberg, and Sauerbruch

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A Principal of the Doncaster Technical College—The Secretary, Education Offices, Doncaster (Jan 12) An assistant pathologist at the Sheffield Infirmary and demonstrator of pathology in the University of

Sheffield—The Registrar, University, Sheffield (Jan 14) Three assistants at the Acton Junior Technical School for, respectively, electrical engineering, mathematics and English, and machine tool practice, workshop processes, and mechanical drawing—Dr J E Smart, Education Offices, Acton, W 3 (Jan 17) Two assistants on the higher technical staff of the Science Divisions of the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S W 7 (Jan 24) A post graduate student at the Long Ashton Research Station of the University of Bristol for a special research on the synthesis of organic compounds—The Director, Agricultural and Horticultural Research Station, Long Ashton, Bristol (Jan 26) A teacher of marine engineering and a teacher of ship carpentry and boat construction at the Marine Industrial School, Suez—The Under Secretary of State, Ministry of Education, Cairo (Jan 31) A professor of engineering (mechanical engineering and motive power) at the Imperial College—City and Guilds College, South Kensington—The Academic Registrar, University of London, S W 7 (Feb 16) Three officers for the Forest Service of Burma—The Secretary, General Department, Office of the High Commissioner for India, India House, Aldwych W C 2 (Feb 16) A professor of botany and a professor of commerce in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, 73 Strand, W C 2 (Feb 28) A temporary full-time assistant master for engineering subjects—The Principal, Technical Institute, Ashford, Kent Two officers for the regional organisation of broadcast adult education in Yorkshire and the West Midlands—The B B C, Savoy Hill, W C 2

ERRATUM —Prof L D Mahajan has pointed out that in line 6 of his letter entitled "Liquid Drops on the Same Liquid Surface" (NATURE, Nov 15, 1930, p 761), he gave the height of Den Kund incorrectly as 1000 ft instead of 10,000 ft

Our Astronomical Column

Large Fireballs —Mr W F Denning writes that on the early evening of Dec 27 last at 5 45 P M a large detonating fireball was observed from several parts of England Mr G H Brown, of the meteorological station at Horfield, Bristol, described the object as very large and bearing a broad train of sparks The fireball moved at a low altitude along the southern sky from east to west, it looked like a large firework and gave a very impressive spectacle It fell at an angle of about 30° The object was also seen on the east coast at Eye, and it traversed a course from under θ Aquilæ to beyond and under the three well known stars in that constellation Another record comes from near Finistère, in the north west of France, where the inhabitants were alarmed by the appearance of a great detonating meteorite

The observations show that the fireball passed over the north of France and must have suffered disruption and collapse in the neighbourhood of Finistère The real path will be investigated, and it seems that the radiant was either in Perseus, Auriga, or Orion, which have yielded large fireballs in past years from the same positions

The Finistère fireball was followed by another at 12 20 P M on the same date It illumined the heavens with a degree of intensity which startled some of the spectators One report states that the flight of the object was perpendicularly downwards in due west It ejected a stream of bright sparks as it descended, several people watched it, without, however, being able to record its exact place by the stars Its radiant point may have been in Auriga, but more observations are necessary It could scarcely have belonged to the system which supplied the brilliant apparition earlier in the night

Absorption of Light in Space —A paper by Dr R J Trumpler in *Publ Astr Soc Pacific* for August 1930 gives reasons for believing that there is a sheet of light absorbing matter distributed over the galactic regions and extending to a distance of 100 parsecs or more on each side of the central galactic plane This result was first arrived at by a study of the open galactic clusters and then confirmed from other material The amount of absorption is given as 0 7 mag at a distance of 1000 parsecs for light of wave length 4300 It is concluded to be less for red than for blue light, amounting only to 0 38 mag at 1000 parsecs for wave length 5500 It is noted in corroboration of this that the *O* stars, though probably the hottest of all, appear yellower than the *B* stars owing to their greater distance

From consideration of the possible mass of the interstellar matter, it is concluded to be not in separate atoms but in particles the mass of which is of the order of 2×10^{-19} gm (that is, some 3400 calcium atoms) There appear also to be free atoms of calcium and sodium to account for the fixed lines of these elements in the spectra of distant stars, but the selective absorption is not due to these The dark patches in the galaxy may be due to specially dense clouds of the general obscuring matter

Since the spiral nebulæ and the globular clusters are at a considerable distance from the galactic plane, their light traverses a comparatively short distance of the sheet of absorbing matter Hence their loss of light is small, and the distances derived on the assumption of no absorption are not greatly in error

The dark equatorial bands seen in many of the spiral nebulæ afford an additional argument in favour of the presence of a similar layer in our own galaxy

The Leonid Meteors —It has already been noted in this column that a fairly rich shower of these meteors was seen in North America on the morning of Nov 17 The *Daily Science Bulletin* of Dec 18, issued by Science Service, Washington, D C, states that a still richer display was seen on Nov 17 by G T Bieling, officer of the steamer *Annetta*, which was then near Porto Rico The display lasted from midnight (Eastern Standard Time) until dawn, being greatest at $3^h\ 40^m$ A M "One was a brilliant fireball, that exploded in a flash so bright that an excellent photograph could have been taken by its light A luminous trail was visible for 25 minutes"

These observations give some ground for hope that the rich portion of the Leonid stream has not finally deserted the neighbourhood of the earth, and that the next few Novembers may retrieve the general disappointment produced by the failure in 1899

Research Items

The Azande Law of Legitimacy—Further impressions of the Azande are recorded by Major P M Larken in *Sudan Notes and Records*, vol 13 Zande law appears to be one of compensation, directed almost entirely to the satisfaction of the individual and, except indirectly, not safeguarding the rights of the community Death was the punishment for malicious magic and for concealing cases of smallpox, but beyond this, there was no idea of a malefactor suffering for having infringed the law established for the protection of the tribe as a whole Though for some offences a plaintiff might press for the death penalty, the majority of acts were compoundable by the payment of damages A man who wished to marry a girl addressed himself to her father or guardian The bride price was twenty spears, which was paid to the father and not to any other member of the family Children born without payment of spears were illegitimate and, as such, the property of the mother's family If they were girls, the mother's next of kin was entitled to the bride price Any boys among illegitimate children were entitled to their sisters' bride price which did not in that case go to the mother's next of kin A payment of only one or two spears was sufficient to legitimise the children, provided the balance was paid fairly quickly If the father refused to complete payment of the price, the chief would probably order the return of the woman with her children to her family, the father retaining one child in consideration of part payment of the bride price The father had a legal right to legitimise his children by paying spears, and his wife s family had no right to refuse Children of women captives of war, or given in payment of a debt or as presents by a former husband, were legitimate only if their father had paid the bride price for their mother

Earliest Cultures of the South-Western United States—Dr E B Renaud of the University of Colorado, describes the results of a series of explorations in caves and rock shelters of New Mexico and Oklahoma during the summer of 1929 in *L'Anthropologie*, T 40, No 3 The oldest remains from this part of the United States are those of 'Folsom man', a series of very fine lance heads found during 1927 and 1928 in the Folsom gravel pit in association with the bones of an extinct bison For these relics Pleistocene age has been claimed Of this early period, Dr Renaud's expedition of 1929 produced nothing but a fragment of an implement of the Folsom type The evidence points to a very primitive culture of a hunting people, probably with only temporary habitations Exploration of the caves of the fumaroles of the Cimarron valley established two horizons, separated by a considerable interval of time, of which the lower represented a long occupation by hunting nomads A considerable number of stone implements were found, which in their general appearance recall the Mousterian of Europe They were followed after an interval, represented in one cave by a layer of 20 cm thickness, by another people, who, though still hunters, seem to have made a greater use of vegetable foods, as is indicated by the presence of 'metates' for grinding seeds Next in the sequence comes the culture of the caves of Oklahoma, of which a number were explored at Kenton The stone industry in quartzite exhibits a great variety in form and purpose Though less coarse than that of the fumaroles, it is purely utilitarian and shows no effort to attain beauty of form These caves being dry, a number of objects of wood, sandals, basketry, and fibre work had survived These people had taken to agriculture, although still hunters Their culture is comparable to that of the Basket-makers Next in order came the volcanic caves of New Mexico, where was found a culture similar to that of the Oklahoma caves, with implements of stone, bone, and wood, the coarser character of the stone implements being due to use of inferior material The evidence for a rudimentary culture of maize was reinforced by male and female figures made from maize cobs, sometimes 'accouplés' and, therefore, obviously magical

Population Census—In view of the approaching census, it may be of interest to recall that Prof Raymond Pearl and Mr Lowell Reed published in 1920 a forecast of the population of the United States up to 2100 based upon data obtained by fitting a logistic curve to the census counts of the population from 1790 to 1910 Prof Pearl and Mr Lowell now compare their forecast with the actual counts of the 1920 and 1930 censuses (*Science*, Oct 17, 1930, p 399) The forecast figures in millions were 107 4 for 1920 and 122 4 for 1930, the actual census figures being 105 7 and 122 7 respectively The forecast thus missed the counted population by 16 parts in a thousand in excess for 1920 and by 2 5 parts in a thousand in defect for 1930

Chinese Ants—Prof W M Wheeler (*Bull Pekin Nat Hist*, vol 5, pp 53 81, 1930) states that the Chinese ant fauna is a mixture of two components one of which is Palæarctic and the other Indo Malayan and representing a northward and eastward migration of species from Indo China, Siam, Burma, and India The ant faunas of Japan and Formosa exhibit a similar mixture of two components the Palæarctic being greatly in excess of the Indo Malayan in Japan, and the Indo Malayan greatly in excess of the Palæarctic in Formosa This island possesses a considerable number of endemic species of palæotropical affinities, but endemicity is meagre in the ant fauna of Japan, indeed, so many of the ants formerly supposed to be peculiar to Japan have been found in China that the species of the two countries may be said to constitute a single fauna—the Sino Japanese The list of Chinese ants which follows includes 138 species, 54 sub species, and 53 varieties, for each of which the author gives a reference to the original description, cites the type locality, and mentions the Chinese localities from which material has been received The Palæarctic component comprises 29 species, 11 sub species, and 16 varieties—about 23 per cent of the entire fauna The remainder is the Indo-Malayan component

Development of the Rabbit Embryo—In *Contributions to Embryology* (vol 21, 1930), issued by the Carnegie Institution of Washington, Mr P W Gregory gives a vivid picture of the earlier stages in the formation of the embryo of the rabbit By applying an exact technique to a very large number of pregnant does, he has confirmed an observation made by Dr Martin Barry in 1839 that the egg is shed from the ovary and enters the oviduct 10 hours after coitus, and that the male element fertilises the egg 2 hours later In 10½ hours after fertilisation the egg is undergoing its first cleavage, in 2 hours more it is forming its 4 celled stage, in another 6 hours it has passed into the 8 celled stage, the 16 celled stage is entered at the end of the second day following coitus At the end of 70 hours, counting from the time of coitus (60 hours from fertilisation), the ovum passes from the oviduct into the uterus, being then in its 16 celled stage At the time of this passage the ovular mass has become differentiated into an inner

cell mass enclosed within a surrounding protective envelope of the trophoblast. The author pays a tribute to the exactness of a similar investigation which the late Prof. Assheton, of Guy's Hospital, published in 1894.

Effects of an Epicaridan Parasite.—B. W. Tucker (*Quart. Jour. Micr. Sci.*, vol. 74, part 1, Sept. 1930) points out that the effects of epicaridan isopods on their hosts have not hitherto been studied in detail. He found in Naples in 1924 that 21·5 per cent of the specimens of the burrowing decapod crustacean *Upogebia* were parasitised by the epicaridan *Gyge branchialis*. Fixation of the parasite to the host normally takes place when the latter is 17 mm. in length. The length of life of *Upogebia* appears to be about three years, and that of the parasite is normally coextensive with that of its host. The effect of the parasite on the general vitality of the host is negligible—moulting and growth are not materially affected. Parasitised male *Upogebia* have chelæ agreeing in size and appearance with those of the female, and they develop the appendages of the first abdominal segment which are normally present in the female only. Parasitised females are unaltered externally. Scattered oocytes occur among the male germ cells in the testes of many normal males, and are eventually shed into the lumen of the testes, where they degenerate. Whether they arise from modified spermatogonia or are distinct from the outset was not ascertained. The testis in parasitised males shows all stages from slight reduction to complete atrophy and the tendency to develop oocytes is much accentuated; in a few cases a tract of testis appears to have been completely converted into ovary. In the large majority of parasitised females the gonad is entirely absent; in the remainder the ovary is in a state of diminished activity but not otherwise abnormal. The modifications of sex characters in parasitically castrated Crustacea are exclusively in the direction of feminisation and cannot be interpreted as a return to primitive or juvenile features. Geoffrey Smith's theory—that the parasite, by withdrawal of nutriment, reacts on the host in a manner similar to an adult ovary—is considered to be the only one which makes any approach to a real explanation.

A New Tetraploid Species-Hybrid.—Three cultivated species of the Convolvulaceous genus *Quamoclit* have been studied by Sigeroku Nohara (*Jour. Coll. Agric. Imp. Univ. Tokyo*, vol. 11, No. 1), who has also studied their hybrids. *Q. coccinea* and *Q. pennata* differ markedly in cotyledon and leaf form as well as flower shape and colour. The F_1 is in general intermediate and sterile. There are also two forms of *Q. pennata*, one having rose red flowers and the other a corolla which is white tinged with dilute greenish yellow. The F_1 of the hybrid between these forms is also intermediate. A third species, *Q. sloteri*, has been much more recently introduced into Japan. It appears to have been collected first in America in 1849 by George Englemann, of St. Louis. Dr. Kano has determined the chromosome number of this species as 30 (haploid), and that of the other two species as 15. Hence *Q. sloteri* is tetraploid. It has larger pollen grains than the other species and is probably a cell giant. It resembles in many respects the (sterile) F_1 hybrid obtained by Nohara by crossing *Q. coccinea* with *Q. pennata*, but is stouter and fertile. Hence it is probably a hybrid species, having arisen either in Nature or under cultivation by chromosome doubling in the sterile F_1 hybrid. *Q. sloteri* is now a fixed race, but it gave rise in cultures to a reversionary type resembling the F_1 of *Q. coccinea* × *Q. pennata*. The chromosomes of this plant were not counted, but it was probably diploid. *Q. sloteri* crossed with *Q. coccinea* also gives sterile hybrids which will no doubt be found to be triploid.

The Scientific Pruning of Vines.—"The Fruiting Habits and Pruning of the Campbell Early Grape" is the title of *Technical Bulletin* No. 106, published by the Agricultural Experiment Station of Michigan State College. The writer is N. L. Partridge, who has treated his subject very thoroughly. Studies on the relation to the yield of fruit of current season's growth, diameter of shoot, position of the fruit on the canes, size of cane, internodal length, and other factors have been made, and the results considered in relation to practice. The variety 'Campbell Early' yields most good produce from large diameter shoots, whilst its sister variety 'Concord' produces its best bunches on shoots of moderate size. It is best to leave about fifteen internodes on shoots of 'Campbell Early'. Shortening beyond this length materially reduces the yield. If the vine will not support four canes of this size, it is better to reduce their number rather than to shorten them. This knowledge is very valuable, for it introduces the grower on one hand, and the scientific worker on the other, to a much neglected field of inquiry. It would be very helpful if we had similar studies of our English horticultural plants, coupled with detailed biochemical investigations.

A Disease of the Douglas Fir.—The genus *Phomopsis* has provided many puzzles for mycologists in the past, and our lack of knowledge became acute when it became necessary to differentiate *Phomopsis Pseudotsugæ*, a disease of the Douglas fir, from other closely allied fungal parasites. A detailed study of the genus by G. G. Hahn (*Trans. Brit. Mycol. Soc.*, vol. 15, parts 1 and 2, pp. 32-93, 1930) has done much to elucidate the facts concerning such species as attack conifers. Eight of the latter have been described in great detail, and a dichotomous key has been devised to separate them. *Phomopsis occulta* has been proven the same fungus as *Diaporthe conorum*, thus adding weight to the prevailing idea that *Phomopsis* represents an imperfect stage of *Diaporthe*.

Salt-Plugs in Southern Persia.—An important paper by J. V. Harrison on the salt-plugs of Laristan has appeared (*Quart. Jour. Geol. Soc.*, vol. 86, pp. 463-522, 1930). The extrusive salt has come to the surface at different periods from Oligocene to Pliocene, has formed hills and salt gypsum 'glaciers', and after erosion has in some cases left great corries in the limestone mountains of the region. The salt always comes up from below, and in widely different localities of the Persian Gulf territory has brought up with it Middle Cambrian fossils, as well as boulders of rocks which have no parallel in the succession of exposed systems from Ordovician to Pliocene. The salt plugs lie in the autochthonous area in front of the South Persian nappes, and it is suggested that they originated where compression acted upon mobile salt and gypsum beds of Cambrian or even greater age. Compression may arise from tangential pressure or from the weight of the overlying strata, but once the salt has accumulated at an underground nucleus, it is still not clear what was the source of the energy that drove the salt to the surface. The hypothesis of salt movement through solution and recrystallisation is no longer accepted. The salt has responded to external forces as a plastic material, and the resulting tectonics are transitional between the disharmonic folding of less mobile incompetent strata and the intrusions of more mobile igneous magmas.

Partial Absorption of X-Rays.—The issue of the *Zeitschrift für Physik* for Nov. 27 contains a paper by Dr. B. B. Ray, in which he describes with some detail his experiments on the partial absorption of X-rays. This effect, to which several references have been made in NATURE recently, appears to consist in the transfer of energy from an X-ray quantum to an electron in a light atom without important deviation of the quantum. The spectra have been recorded photographically with a Siegbahn vacuum instrument, and the paper is illustrated by reproductions of three plates, which show unambiguously the lines in question. Dr. Ray mentions that these are not coincident with lines which might have been produced by impurities, and that they are also distinguished by being somewhat diffuse. The width of the lines is stated to correspond, in order of magnitude, to the ionisation potential of the absorbing atoms, and the conclusion is reached that the electron responsible for the change in energy of the radiant quantum may be transferred to an optical energy level of the atoms, or expelled with zero velocity. Dr. Ray adds some remarks on the apparent magnitude of the absorption coefficient of X-rays when various dispositions of apparatus are made, and upon the *J* phenomenon.

Black-Body Radiators.—A. C. Egerton and M. Milford describe two forms of black-body radiator in their paper on optical pyrometry in the December number of the *Proceedings of the Royal Society* which, although not completely novel in principle, afford simple and relatively inexpensive sources of full radiation. The first consists of a wedge of thin platinum foil which is heated electrically, either in a vacuum or in hydrogen or argon. With an angle of 10°, such a system is known to be within less than one per cent of 'black'. The other consists of a tube of platinum (1.4 mm. external diameter, 10 cm. long and 0.15 mm. thick) with a 0.3 mm. hole in the middle of the wall, through which the internal black-body radiation can be investigated. Both forms were used with various minor modifications, temperatures being preferably determined by the melting of wires hung down the middle of the tube. A monochromatic filter, for which a 'didymium glass' is employed, is also described, transmitting a band of light between 5740 A. and 5600 A.

A Differential Ebullioscope.—Under the title "Construction of a Differential Ebullioscope for determining the Purity of Individual Liquids and of Azeotropic and Eutectic Mixtures", Prof. W. Swietoslawski, of the Warsaw Polytechnic, describes (*Roczniki Chemji*, **10**, p. 570, 1930) a new type of ebullioscope. It consists essentially of two similar sections so that the vapour formed when the liquid in the lower part is heated then passes through the upper section, the object being to observe both the boiling point, tH, and the condensation temperature, tB. Prof. Swietoslawski also describes a micro-ebullioscope for the study of relatively small quantities of liquids. The special advantage of this ebullioscope is that it enables a careful study of the boiling temperatures of pure solvents and of 'constant boiling' mixtures to be made. Furthermore, it is shown that the boiling point, tH, and the condensation temperature, tB, are identical when no impurity is present. With his collaborators the author has examined a number of pure liquids and azeotropic and eutectic mixtures, temperatures being measured by a small Beckmann thermometer and also electrically. For methyl alcohol (Poulenc) $tH - tB = \Delta t = 0.043°$ C., methyl alcohol (Riedel de Haën) showed $\Delta t = 0.023°$, whilst a German preparation had $\Delta t = 0.000°$. When, however, the last sample was allowed to stand for several months in the apparatus, it showed a difference of 0.052° C. Toluene-free benzene (Merck) also had $\Delta t = 0.000°$; toluene (Merck's "chemically pure" for molecular weight determinations) gave $\Delta t = 0.040°$, whilst purified and dried carbon disulphide gave at first $\Delta t = 0.008°$, and after a further purification, $\Delta t = 0.000°$.

Crystalline Modifications of Electrolytic Chromium.—Bradley and Ollard (NATURE, **117**, p. 122, Jan. 23, 1926) stated that chromium prepared by a special method is a mixture of two allotropes, a body-centred cubic form and a hexagonal close packed form. Later workers, however, reported that the electrolytic deposit consists only of the body-centred cubic structure. In the *Journal of the Society of Chemical Industry, Japan*, November 1930, vol. 33, No. 11, however, Sasaki and Sekito state that they have confirmed the existence of both the forms described, which are produced by the method of Ollard, and they have also found another modification of the same type as α-manganese, with 58 atoms in a unit cube. X-ray methods were used and details of the lattice structures are given.

Organic Compounds of Gold.—Diethyl gold bromide, $Au(C_2H_5)_2Br$, first described by Pope and Gibson in 1907, is shown by Gibson and Simonsen, in the November number of the *Journal of the Chemical Society*, to have a doubled formula in benzene solution. In the associated form the gold atom has a completed octet of electrons. Experiments are described which show that gold in these compounds has a co-ordination number of four, and a slow hydrolysis of the compound in water is assumed to be due to the formation of an aquo salt, $[Et_2Au(H_2O)_2]Br$, giving the reaction for the bromine ion. Amino diethyl gold bromide, $(C_2H_5)_2AuBr,NH_3$, and pyridino diethyl gold bromide, $(C_2H_5)AuBr,C_5H_5N$, the first compound being previously described by Pope and Gibson, were prepared. They are colourless, highly crystalline compounds with similar properties, sensitive to light, soluble in organic solvents, and almost insoluble in water. Other interesting compounds, such as diethyl gold acetyl acetone, are described in the paper.

Stereochemical Influence on Substitution.—Mills and Nixon in the November number of the *Journal of the Chemical Society* describe some experiments with substitution derivatives of δ-hydroxy hydrindene which have a bearing on the configuration of the carbon valencies in the benzene ring. If, in a doubly bound carbon atom, the angle α between the two single bonds is the same as that between the valencies of the carbon atom in methane, 109.5° according to the tetrahedral theory, then the angle β which the single bonds make with the plane of the double bonds would be 125.25°. On the assumption that the external angles are increased approximately proportionally when the internal angle of each CH residue is reduced to 120° in the formation of a Kekulé benzene nucleus, the angle α which each of the external valencies makes with the intranuclear single bond on one side of it is less than that, β, which it makes with the plane of the double bond on the other side. In compounds in which the benzene ring is fused with appropriate five-membered rings, the stable compound will be that in which the linking common to the two rings consists of a single bond, since this will be under the less intramolecular strain caused by the approximation of the intervalency angles to 108°. The effects of fusion of a benzene ring with six-membered rings are also considered. The experiments described in the paper are held to confirm the results anticipated from theory.

Early Human Types and Culture Sequences in South Australia.

PRELIMINARY observations on two adjacent sites in the Lower Murray Valley which have an important bearing on the antiquity of man in South Australia are described in vol 4, pt 2, of the *Records of the South Australian Museum*, by Mr Herbert M Hale, curator, and Mr Norman B Tindale, ethnologist of the Museum The sites are in the neighbourhood of Old Devon Downs, seven kilometres below Nildottie township One was an island, Tartanga, between the river and a lagoon, the other a cliff shelter opposite Old Devon Downs station and a kilometre and a half west of Tartanga, the existence of which had already been reported by Sheard in 1927 In the same year a human skeleton was found by Mr A R Roy embedded in sand rock in this part of the Murray Valley and it was decided to undertake the examination of the sites Operations began in April and were continued in November and December 1929

At Tartanga, beneath four layers of 'recent' deposits, five consolidated strata were examined, of which the lowest and earliest, *A*, represented the lagoon shore, while *B* to *E* above represent successive surfaces of an old island now nearly eroded on the western side of the lagoon All show signs of human occupation except *F* and *G*, which are practically sterile Borings below *A*, which was not very deeply excavated, suggest that there are at least two further strata below with signs of human occupation

Of the five consolidated strata *A*, the lowest, though not extensively examined, yielded burnt stone, suggesting hearths, stone chippings, and shells of mussel (*Unio*) In the strata *B* to *E*, among the food debris were quantities of mussel shell (*Unio proto vittatus* n sp, which differs in having a uniformly thicker shell from the *Unio vittatus* now common in the adjacent lagoon), jaws and vertebræ of fish, fresh water tortoise, birds (unidentified), and bones of mammals (opossum, wallaby, kangaroo) Flakes, chippings, and implements of stone and bone occurred throughout the layers Skeletal remains representing three individuals, including the skeleton found by Mr Roy, were recovered An examination of the dentition, possible in two cases, showed that it was superior to that of the present Australian aborigines and belonged to children of from ten to twelve years of age The remains were mineralised and firmly embedded in the matrix Above the sterile strata *F* and *G*, *H* showed hammer stones and high backed knives similar to implements known to aborigines now living near Lake Eyre, while *I* showed traces of recent occupation

In the cliff-shelter the deposits were excavated to a depth of four metres, and in twelve successive layers showed four cultural stages Skeletal remains of several individuals were found—all children In one case, found in the third layer from the top, the teeth showed strongly marked simian characteristics

The cliff shelter cultures follow the Tartanga culture after a considerable but undetermined interval The first two culture phases have been named 'Pre Pirrian' and 'Pirrian', the latter being characterised by a leaf-point artefact with retouched edges and prepared butt which has been christened 'pirri', a well-known type on old camp sites in many parts of South Australia but not observed among living tribes This culture was followed suddenly by a people who apparently at first fed largely on the small mammals of the plains, but nevertheless possessed double pointed fusiform fishing bones, 'muduk', whence the culture is to be called 'Mudukian' This culture was rich in stone and bone industries It was followed by the 'Murundian', so called from a local sub tribe, and divided into an early and late phase, of which the latter may represent the culture of the district when first visited by the white man Local native legends indicate that within tribal memory there has been a southward movement of people from up the river It would seem that if this movement is linked with Murundian levels, the latest cultural phase has not extended to the coastal parts of eastern Victoria, where the people of a somewhat earlier phase, possibly Mudukian, existed until the present time Contemporary with Mudukian and Murundian, early and late, are rock markings which show three distinct types The occupation of the shelter was sufficiently long to admit of a number of faunal changes, possibly due to climatic variation

The interest of the investigation of these two sites lies only partly in the fact that they are the first old camp sites in Australia on which a cultural sequence has been worked out in association with human remains after an excavation which has been conducted in strict accordance with archæological methods, Tartanga has an additional importance in the fact that it has been suggested, after an initial comparison, that the Tartanga human remains when examined in further detail may be found to represent a type intermediate between the modern Australian aboriginal and the Talgai skull, which is claimed to be of Pleistocene age

Noise and its Measurement.

THE Noise Abatement Commission, Department of Health, City of New York, has now published the report of the committee appointed by Dr Wynne on the noise in New York City and on the best way of diminishing it It gives the results arrived at by experts in neurology, otology, law administration, acoustics, engineering, and the motor car industries They have definitely established laws which have hitherto only been vaguely suspected The committee has effected some progress in the direction of noise abatement

The shipping companies have co operated with the committee in diminishing the noises of steam whistles and sirens The drivers of mail motor vehicles have instructions that their horns are only to be used for the purpose of preventing accidents Noiseless turnstiles have been invented and are being used at several railway stations The Health Commissioner and the police have special powers to control the indiscriminate use of loud-speakers

In addition to getting the law amended, engineers have been encouraged to invent less noisy machinery and motor cars The Press also is educating the public to realise the costliness and danger to health due to much needless noise It is pointed out that the noise in cities like London, Paris, and Berlin is not nearly so nerve racking as the noise in New York The erection of buildings goes on much more leisurely, and in European cities there is little complaint from neighbours about harsh and blatant loud-speakers and there is little outpouring of radio programmes into the streets day and night It is said that taxi drivers in New York are becoming hard of hearing, and that boiler workers and other

mechanics exposed to a constant riveting noise are also becoming very deaf

The absolute amounts of energy in the sounds of ordinary experience are exceedingly small in comparison with those of other forms of energy For example, the power equivalent of more than one million voices is necessary to light an ordinary electric lamp The average speech power of the loudest single voice is about 1000 microwatts, and this falls to 0 1 microwatt for the quietest speech and to about 0 001 microwatt for the softest whisper However, in most energy measurements of applied acoustics the interest lies not so much in the intensity of the sounds as in their loudness, that is, in the intensity effect produced upon the ear by them, and further, it is well known that the increase in power necessary to produce a perceptible increase in loudness depends upon the initial intensity of the sound

From these considerations it is clear that in problems concerned mainly with power differences, whether acoustic or electric, a special unit is convenient, and that now being adopted in telephony is the *bel*, so named as a tribute to the inventor of the telephone Two amounts of electric or acoustic power P and P_0 are said to differ in power level by n bels if $n = \log_{10}(P/P_0)$ The most convenient unit for most practical work is one tenth of the bel, the *decibel* (db) known also as the *transmission unit* (T U) Further subdivision of the bel is unnecessary, since a change of the power level of a sound by one decibel is about the smallest which can be detected by ear It is unfortunate that another term, the *sensation unit*, is used in this connexion for the decibel by otologists, psychologists, and physiologists Since, for pure tones, equal steps on the logarithmic scale sound approximately like equal loudness stops, and since a power change of one decibel is approximately the smallest such step detectable by ear, the sensation level of any sound reaching the ear is conveniently represented by the number of decibels it is above the threshold level for audition In this connexion the term sensation unit is often used instead of decibel

An idea of the size of the decibel can be obtained from some actual examples If, in the discussion of speech power, the average speech power be taken as the zero level for comparison, then the level of very loud speech would be +20 db , of weak speech −20 db , and of a soft whisper −40 db In measurements made on many speakers it has been found that the range of average powers used in conversation by the majority is about 21 db Measuring from the limit of audibility, speech would be received at a level of 100 db if the lips of an average speaker were within half an inch of the ear of a person having normal hearing Measuring from the same level, the roar of street traffic in a city would be received at a level varying from 50 db to 80 db , and the noise of an underground tube train passing a station at about 96 db Two special gramophone records have been prepared in the Bell Telephone Laboratories, New York, in which the same complex sounds can be heard at different levels (see NATURE, 125, 394 , 1930)

The Antiscurvy Vitamin in Apples

A BRIEF reference has already been made in these columns to a preliminary report by Zilva and his associates of their work on the antiscorbutic potency of apples (NATURE, vol 126, p 248 , 1930) The full experimental details of this research have now been published *

In spite of much work on the properties of vitamin C, success has not yet attended attempts at its isolation it is known, however, to be very susceptible to oxidation but to be stable to heat in the complete absence of oxygen Its behaviour depends in part also on the presence of other substances in its natural sources , thus in lemon juice a reducing factor helps to maintain its activity, and destruction of this factor always leads to loss of potency Deterioration of heated lemon juice is rapid on storage, and autoclaving the juice results in the appearance of a destructive factor (Zilva, *Biochem Jour*, vol 23, p 1199 , 1929) It is not destroyed by fermentation and is most stable at the natural acidity of the juice , but is unstable under conditions detrimental to the growth of moulds and bacteria (J Williams and J W Corran, *ibid*, vol 24, p 37 , 1930) It is precipitated by basic but not by neutral lead acetate , its activity is not dependent upon the presence of amide nitrogen, but iron, phosphorus, and sulphur are present in the most concentrated preparations so far obtained, though whether these elements are related to the potency is not known It has been suggested that it is a weak acid (R B McKinnis and C G King, *Jour Biol Chem*, vol 87, p 615 , 1930)

Since chemical purification leads to increasing instability, indirect methods of approach, such as the establishment of a relationship between the antiscorbutic potency and the physiological condition of a plant, would at any rate increase our knowledge of the vitamin's properties and might even lead to its isolation Zilva and his associates, therefore, have begun an investigation into the antiscorbutic activity of different varieties of apples, grown under different conditions and stored for varying lengths of time Their results, although of a preliminary nature, have led to some interesting conclusions The work is laborious, since all tests have to be carried out on guinea pigs , the animals are given a diet of bran, barley meal, middlings, fish meal, and crushed oats together with autoclaved milk, on which, if no source of vitamin C is provided, they die from scurvy in 4 5 weeks

Different varieties of apple were found to differ considerably in their antiscorbutic potency Bramley's Seedling was the best, a daily dose of 3 gm preventing the onset of scurvy and usually permitting of a fair amount of growth , King Edward had the lowest potency, a daily dose of 20 gm failing to prevent the onset of scurvy, although it prolonged life The protective doses of other varieties were Dabinett, 10 gm , Woodbine, 20 gm , Cox's Orange Pippin, slightly more than 20 gm , whilst for Worcester Pearmain, 20 gm failed to give complete protection No relationship was detected between antiscorbutic potency and the age of the tree, the soil or the season, or the date of picking the fruit

Slight loss of potency occurred on storage at 1° C in air, and a slightly greater loss was observed at 10° C in an atmosphere containing 10 per cent carbon dioxide, 11 per cent oxygen, and 79 per cent nitrogen Bramley's seedling survived storage, especially gas storage, better than Cox's Orange Pippin A number of imported varieties were also tested, and it was found that Canadian were more active than Australian or New Zealand probably due to the fact that the time between picking and test was greater in the case of the latter

* 'The Antiscurvy Vitamin in Apples By Mary F Bracewell, E Hoyle, and S S Zilva Medical Research Council, Special Report Series, No 146 London H.M Stationery Office, 1930 Pp 45 9d net

The effect of heating fresh and stored apples in their skins at 115° C in air for 50 min was studied no significant loss in potency was observed Some chemical analyses were also carried out In general, the chemical composition of the different varieties was very similar but in some preliminary experiments it was noticed that the nitrogen content of King Edward was about twice as great as that of Bramley s Seedling

In conclusion, the authors point out that the high antiscorbutic value of Bramley's Seedling, fresh or stored, cooked or uncooked, is of interest to the dietician, but that the lower potency of other varieties scarcely lessens their nutritive value, since they are consumed under conditions in which the vitamin C requirements are usually fully covered by the general diet

Industrial Health Research Board

THE tenth Annual Report of the Industrial Health Research Board contains an account of the work done during the year 1929 The report is divided into two sections the first dealing with problems of general industrial importance and the second with more specific problems submitted by Government departments and industrial associations

In the first section an account is given of researches into (a) Heating and ventilation and in this connexion it is stated that rooms heated by under floor and ceiling panel systems feel warmer and more comfortable than rooms heated by stoves or hot water radiators and it is claimed that these systems have certain advantages in factories and for open and semi open air schools

(b) Vision and lighting Further experiments are reported on the use of special spectacles in very fine processes, and a very interesting research shows that even coarse work can be substantially improved by increasing the illumination Arrangements are also being made to study the effect of natural ultra violet radiation on factory workers

(c) Noise and vibration studies have so far revealed little in the way of positive results

(d) Accidents causation researches have been still further extended and the results of tests on 1800 subjects are recorded The original conclusions, published previously have been in the main substantiated namely that there are certain workers who are prone to accidents and that these may be detected by tests It would be interesting to know if the people who have street accidents are of this type

(e) The problem of sickness absenteeism is receiving attention from several angles On one hand, there is a general study in progress of the actual sickness occurring in different firms, and the medical diagnoses while on the other, absenteeism among special groups for example, coal miners, printers, cardroom operatives A difficulty in this field is that relatively few firms have as yet realised the importance of accurate detailed sickness records Closely linked up with this problem is that of psycho neurotic illness, and a special investigation of psycho neurotic symptoms among industrial, clerical, and professional occupations is in progress

(f) Other studies relate to the physiology and psychology of work, and to the occupational fitness of mental defectives

The second section describes work done on problems submitted by Government departments and industrial associations The sickness investigations among printers and others have already been mentioned In addition there is an account of the effects of baths at the pit head and various investigations on the fundamental principles underlying vocational tests It is hoped to discover what qualities a candidate possesses rendering him more suitable for one occupation than another

Some researches, owing to the nature of industrial conditions, cannot be conveniently followed in a factory and in these circumstances arrangements are made with various universities to obtain special laboratory conditions The problems of this kind reported refer to the extent to which acquired skill is transferred from one process to another, the relative effects of concentrated and distributed practice, the characteristics of learning curves the effects of variety and uniformity in work, and the influence of incentives

The Board concludes with an appeal for a wider interest in its work and in its practical applications

Development of River Systems

THAT a river may be diverted by the capture of its headstreams by a neighbouring river has been regarded as well established since the famous paper of Beete Jukes (1862) on the river system of southern Ireland This process has been applied to explain the developments of river systems in all parts of the world, but it is now declared to be impossible on any material scale, by Dr E O Marks, of the Geological Survey of Queensland (*Proc R Soc Queensland*, 1930)

Dr Marks rests his case on a detailed study of the rivers of Queensland The watershed between those that flow inland and those that go eastward to the coast is inappropriately called the Great Dividing Range, which Dr Marks justly rejects He points out that the Queensland Divide has been in places lowered 1000 ft by denudation, and yet the lateral displacement is so trivial that it amounts only to minor nibbling In two cases (the Fitzroy and the Burdekin) the change is more important, as those rivers once flowed west whereas they now discharge east, but this change he attributes to their having overflowed the divide and thus cut it down He calls this river-dumping, not river capture, and says it is not due to encroachment upstream

From the evidence of eastern Queensland Dr Marks argues that the ordinary physiographic view is incorrect, since he holds that denudation by rivers and waterfalls is only vertical and makes no serious encroachment upon the head of the river River capture he declares improbable, and the development of reversed obsequent rivers impossible, and he claims that as watersheds are fixed, 'all that part of physiographical theory which depends on their migration must be discarded

The paper directs attention to the usual nature of the main Queensland divide, its special character appears due to the subsidence of the coastal region, as illustrated by the formation of the Barrier Reef and that it is recent is obvious from the nature of the Barron Falls Australia has provided striking cases of watershed migration The intricate dove tailing of the northern and southern river basins in the Victorian Highlands—where the main watershed has also been called the Main Dividing Range—is due to great changes in the position of a divide by rivers pushing their heads backward The absence of proved displacements of the Queensland Divide does not disprove changes in areas that are geographically much older

University and Educational Intelligence.

BIRMINGHAM.—The degree of D.Sc. has been awarded to Martin Christopher Johnson for published papers on the adsorption of hydrogen and other molecular problems *in vacuo*, and Wilfred John Hickinbottom for numerous published papers in organic and physical chemistry and biochemistry, on carbohydrates, rearrangement of alkylanilines, acetone, butyl fermentation, and distillation of dilute solutions.

CAMBRIDGE.—The Director of the Solar Physics Observatory has, with the consent of the Vice-Chancellor, appointed Dr. R. O. Redman, of St. John's College, to be assistant director of the Solar Physics Observatory for five years from April 1 next.

Dr. C. P. Snow has been elected to a fellowship at Christ's College.

The Council of the Senate has issued a report on the regulations for the Botanic Garden. It is recommended that the Botanic Garden Syndicate shall consist of (*a*) the Vice-Chancellor, Master of Trinity College, the Provost of King's College, the Master of St. John's College, the Regius professor of physic, the professor of botany; (*b*) the present elective members; (*c*) four persons appointed by the Faculty Board of Biology "A"; (*d*) two persons appointed by Grace on the nomination of the Council of the Senate. It is recommended that the present Director shall be responsible for the management of the Garden under the Faculty Board of Biology "A". He shall give assistance to the professor of botany by teaching systematic botany in the Garden and in other ways. When the directorship falls vacant, the professor of botany shall either himself be director, or appoint as director, with the concurrence of the Faculty Board of Biology "A", a University teaching officer in the Department of Botany, the appointment to be made for a limited period, not exceeding five years. A director shall be eligible for reappointment.

A COURSE of six lectures, dealing with "Some Philosophical Aspects of Modern Industrial Society", is to be given by Prof. P. Sargant Florence at the British Institute of Philosophical Studies, University Hall, 14 Gordon Square, W.C.1, on Tuesdays at 5.45 P.M., beginning on Jan. 20. The lectures, which are free to members of the Institute, are open to the general public at a nominal fee. A syllabus of the course, and other particulars, can be obtained from the Director of Studies, British Institute of Philosophical Studies, University Hall, 14 Gordon Square, W.C.1.

THE International Federation of University Women has issued a report of its council meeting held at Prague last July. The Federation now comprises thirty-four national associations of members of the universities of nearly all the countries of Europe, of the United States of America (more than 500 branches), Canada, Australia, New Zealand, India, South Africa, and Mexico. The Prague meeting was signalised by the gift of £1000 by President Masaryk to the Federation's Travel and Research Fellowship fund, completing the endowment of the first of these fellowships. The Federation has issued a complete list of international fellowships available to graduate students, both men and women, wishing to work in foreign countries. It endeavours to promote exchanges of teachers, junior medical officers, museum curators, librarians, archivists, and lecturers. It also organises group travel tours arranged with reference to special professional or cultural interests. For the coming season, tours are being organised in England, Germany, Italy, and Norway. The headquarters are at Crosby Hall, Cheyne Walk, London, S.W.3.

ON Saturday, Jan. 3, the first national conference for advancing the cause of adult education by wireless was opened at the London School of Economics. The conference was composed of representatives of the Central Council for Broadcast Adult Education and the British Institute of Adult Education. Dr. Temple, Archbishop of York, in a letter regretting his absence, pointed out the great importance of group discussions. Such groups are undoubtedly a great asset, since they prevent, as Dr. Temple remarked, the mere reception and indiscriminate assimilation of the material broadcast. It is conceivable that any type of broadcast talk would probably defeat its own object if received without question by the listener. With child education, such a possibility is eliminated by the teacher, who may clarify, stress, or amplify points at his or her own discretion. In the case of adult education, this is naturally very difficult, and therefore the formation of study groups, which promote discussions, is to be encouraged. The growing influence of broadcasting on education, especially in the case of adults, is made evident by the formation of four hundred study groups up to the end of last year. This should encourage the B.B.C. to continue its efforts in wireless education.

Birthdays and Research Centres

Jan. 13, 1869.—Sir RICHARD PAGET, Bart.

I am at present studying the mouth gesture of the root words of modern English, a large proportion of which are found to be pantomimic. Thus, nearly all words beginning with STR have meanings connected with the tongue gesture which produces the STR-sound, namely, a stroking, streaking, or stretching from behind the teeth to near the back of the palate. Linguists might usefully compare the root words for gesturable ideas in the various language groups of the world from the point of view of mouth gesture.

On the experimental side there is a great opening for work with plasticine and rubber models to elucidate the methods of producing different qualities of tone in voice production. The musical experiment suggested on pp. 184-188 of "Human Speech" still awaits a practical trial by three expert players of the Swannee whistle.

Jan. 18, 1868.—Sir LEONARD ROGERS, C.I.E., F.R.S.

A forecast of the probable incidence of cholera, smallpox, and plague in India during 1930, based on the previous year's meteorology on the lines I had worked out, has proved remarkably correct. A similar forecast for 1931 will shortly appear.

A severe epidemic of leprosy in Nauru Island has been reduced by 40 per cent in three years by my plan of clearing up the cases by injections of hydnocarpates in the early stage, discovered by repeated examination of contacts; so the means of stamping out leprosy are now available.

The discovery I made in 1916-18 that the acid-fast bacilli of leprosy can be destroyed in the human tissues by hydnocarpates and morrhuates makes further work on these lines the most hopeful method of treating tuberculous disease. New preparations of hydnocarpus and cod liver oils are now being tested experimentally and clinically against tubercle.

Jan. 22, 1881.—Prof. J. W. HESLOP HARRISON, F.R.S., professor of botany and reader in genetics at Armstrong College, University of Durham.

My researches on the botanical side are mainly directed toward the elucidation of evolutionary problems in the genera *Rosa* and *Salix*. In the section Caninæ of the genus *Rosa*, reproduction, whilst

facultatively sexual, is mainly secured by apogamy or sporophytic budding Recently, however, cases have been detected in almost sterile crosses between *R spinosissima* and the Caninæ in which a true parthenogenesis occurs Offspring so produced is fully fertile and presents novel cytological features Strongly resembling *R spinosissima* and fitted for habitats of that species, such plants become a by no means negligible element of certain *R spinosissima* populations, which thus approach the condition of hybrid 'swarms' The problems presented by these populations are being attacked genetically, cytologically, and in the field

On the zoological side, I have found that the larvæ of the moth *Selenia bilunaria* respond readily to their environment in respect to pigmentation The inheritance (or otherwise) of such colour effects is being studied in crosses between alderwood and hawthorn hedge strains, as well as in others involving larvæ experimentally treated Simultaneously, work proceeds on the inheritance of bivoltinism induced in univoltine northern races of the same insect

Societies and Academies

LONDON

Geological Society, Dec 3 —**H Dewey** The Palæolithic deposits of the lower Thames valley Recent work near Swanscombe (Kent) has revealed some facts of interest with regard to the relationship of the Thames deposits to Palæolithic man The deposits of the 100 foot terrace in the old pit at Milton Street are still being extensively worked They are upwards of 30 feet thick, and are divisible into three beds of sandy gravel, lower, middle, and upper, separated one from the other by beds of marly loam, and they rest upon a clean cut surface, or 'shelf', of chalk and Thanet sand at a level of 88 feet above O D Correlation between the deposits at Milton Street with those at Ingress Vale is established —**P Tesch** The Riss glaciation in the south eastern parts of England The plains of western Germany and northern Holland and the North Sea basin were covered by the ice sheet of the Riss glaciation Short accounts of the fauna and flora of these beds are given in the paper A close conformity is shown to exist between the Dutch deposits and those of Norfolk The author does not agree with the late F W Harmer that the two ice-sheets of East Anglia mark two different glacial periods, but only re advances during one, the Rissian, glacial period

Royal Meteorological Society, Dec 17 —**J Glasspoole** Heavy falls of rain in short periods (two hours or less) The paper gives details of intense falls in 10, 15, 30, and 60 minutes as recorded in 7 years at 14 stations distributed over the British Isles This is a more detailed examination than has been carried out previously, thus, at Camden Square (London) 0 16 inch or more has fallen in 10 minutes on 22 occasions in 7 years, and on the average of the 14 stations 0 80 inch or more has occurred in an hour once in 7 years Details are given of the heaviest, second heaviest, and third heaviest rains in specified times at each station —**M T Spence** The factors affecting visibility at Valentia Observatory This paper analyses by means of frequency tables the relationship at Valentia between visibility and (*a*) cumulus cloud, (*b*) wind force, (*c*) humidity Visibility is better when there is cumulus cloud in the sky than when there is not; it deteriorates with increasing wind force, and improves with decreasing relative humidity down to comparatively low values of humidity The relationship between visibility and cumulus cloud is regarded as showing that visibility at Valentia is generally better in air of polar origin than in air of equatorial origin The deterioration of visibility with increasing wind force is not due to the stronger winds being land winds or to their being more humid than the lighter winds it is concluded, therefore, that sea spray, the amount of which varies with wind force, gives rise to the greater obscurity with strong winds Improving visibility with drier air at comparatively low values of relative humidity may be associated with slow evaporation from the hygroscopic nuclei

DUBLIN

Royal Dublin Society, Nov 25 —**J Joly** The application of gamma radiation to deep-seated tumours (2) An apparatus was exhibited (made in accordance with a design recently published in the Society's *Scientific Proceedings*) whereby two tubular applicators, each yielding a beam of unscreened gamma rays from a suitable radium or radon source, are carried round a template in such a way that the beams intersect at any given distance, and the point of intersection traces out a path determined by the shape of the template The apparatus may be strapped in position on the patient's body and fitted with suitable templates so that all parts of a deep seated tumour may be subjected in turn to the focusing action of the convergent beams A small electric motor with suitable reduction gearing moves the tubes slowly round, or use might be made of the patient's respiratory movements by means of an inextensible belt lined with a light rubber tube lightly distended with air, the variations in pressure of which would provide the requisite power —**H H Dixon** and **G Joly Dixon** The exudation of water from the leaf tips of *Colocasia antiquorum* Schott The liquid issuing from the leaf tips of *Colocasia antiquorum* is practically pure water Hence it has been concluded that osmotic action is not responsible for its expulsion Flood showed by histological and experimental methods that the stream is not due to glandular action The authors demonstrate by simple working models that a continuous stream of pure water may be forced upwards by the osmotic pressure developed by solutions in the lower parts of the plant, and suggest that the pure water emerging is derived from these solutions, which have been depleted of their solutes, as they rise through the capillaries of the conducting tracts —**H H Poole** A modified form of radon capillary apparatus The apparatus in use in the Society's laboratory for supplying radon tubes for therapeutic use has been further modified so as to combine the reliability of yield (90 per cent), obtainable with the original apparatus, with the ease of working characteristic of the modified form introduced two years ago.

WASHINGTON, D C.

National Academy of Sciences, (*Proc.*, vol 16 No 9, Sept 15) —**Paul S. Galtsoff**. The rôle of chemical stimulation in the spawning reactions of *Ostrea virginica* and *Ostrea gigas* Females are induced to spawn by the presence of sperm; there is a lag suggesting that the active principle, which is insoluble, is absorbed through the digestive tract Male oysters are stimulated by egg suspensions when there is no lag, and also by sperm Males respond more readily to rise of temperature One male having spawned stimulates its neighbours both male and female, and so spawning may spread over a whole bank —**Henry Borsook** and **Howard M Winegarden** On the free energy of glucose and of tripalmitin The ratio of the theoretical maximum work obtainable by oxidation under physiological conditions to the total energy of the change i

nearly the same for these substances It seems that fat is burned as such in the provision of energy for muscular work, or the energy released in the hypothetical conversion of fat to carbohydrate is not dissipated as heat but used as work—Wilder D Bancroft and George H. Richter · Claude Bernard's theory of narcosis. Bernard concluded that reversible coagulation of colloids of the sensory nerves produces or accompanies anaesthesia Proteins are important in anaphylactic shock. Assuming that there is increased irritability as the nerve colloids approach instability and the beginning of reversible coagulation, it should be possible to observe, with increasing amounts of anaesthetic, first increased irritability, then anaesthesia, finally death if coagulation becomes irreversible Thus, strychnine may be a stimulant in small doses and cause death in large doses, in an intermediate range of concentrations it is an anaesthetic Similarly, yeast cells narcotised with alcohol show coagulation which can be reversed by removing the alcohol, when the cells recover Thus the difference between an anaesthetic like ether and a habit-forming drug like morphine is that the former is rapidly eliminated whereas the latter or its products is retained, keeping the system irritable Nitrous oxide acts indirectly, it interferes with oxygen metabolism, giving rise to acid products which cause flocculation—Linus Pauling The structure of the chlorites The structure deduced leads to the general chemical formula $X_mY_4O_{10}(OH)_8$, with $4 \leq m \leq 6$—Richard C Tolman Discussion of various treatments which have been given to the non static line element for the universe—Einar Hille and J D Tamarkin On the summability of Fourier series third note—Francis F Lucas The architecture of living cells—recent advances in methods of biological research—optical sectioning with the ultra-violet microscope The ultra-microscope as developed for metallography has been applied to photograph the structure at different planes within a single cell or group of cells The sensitivity of the fine adjustment of the microscope has been increased so that a movement of a quarter of micron is possible and series of photographs at these intervals are taken in the light of a cadmium spark With a transparent specimen, detail above or below the exact focal plane does not interfere with the image, so a series of 'optical sections' is obtained Since organic specimens are differentiated in structure by their selective absorption of ultra-violet light, staining is not usually necessary Some striking photo micrographs are reproduced in the paper—L S Kennison A fundamental theorem of one parameter continuous groups of projective functional transformations—Harry Merrill Gehman A special type of upper semi-continuous collection—R D Carmichael On expansions of arithmetical functions—A D Michael and L S Kennison Quadratic functional forms in a composite range—G C Evans and R N Haskell The mixed problem for Laplace's equation in the plane discontinuous boundary values

Official Publications Received.

BRITISH.

Annual Report on the British East African Meteorological Service, working in connexion with the Conference of East African Governors, 1929 Pp 13+iv (Nairobi.)

The Quarterly Journal of the Geological Society Vol 86, Part 4, No. 344, December 2nd Pp. 463 532+xiv+7 plates. (London Longmans, Green and Co., Ltd.) 7s. 6d.

Proceedings of the Royal Society of Victoria. Vol. 43 (New Series), Part 1, 30th September Pp. v+100. (Melbourne.)

Record of the Royal Institution of Great Britain, 1930. Pp. 148. (London Wm. Clowes and Sons, Ltd.) 5s.

Scottish Marine Biological Association Annual Report, 1929–30 Pp 23 (Millport.)

Imperial Institute. The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports and Exports) 1927-1929 Pp. 371 (London H M Stationery Office.) 5s 6d. net.

The Scientific Proceedings of the Royal Dublin Society Vol. 20 (N S.), No 1 A Modified Form of Radon Capillary Apparatus. By Dr H. H. Poole. Pp 6+1 plate. 1s. Vol 20 (N S.), No 2 The Exudation of Water from the Leaf tips of *Colocasia antiquorum*, Schott. By Prof Henry H. Dixon and G Joly Dixon. Pp. 7 10. 6d. Vol. 20 (N S.), No. 3 The Application of Gamma Radiation to Deep-seated Tumours, 2. By Dr J Joly Pp. 11 12. 6d. (Dublin Hodges, Figgis and Co., London Williams and Norgate Ltd)

Proceedings of the Royal Irish Academy Vol 39, Section A, No 8 The Effect of Water Vapour on the Mobilities of Negative Ions in Air By Prof J J Nolan. Pp 82 99 (Dublin Hodges, Figgis and Co., London Williams and Norgate, Ltd) 6d.

Commonwealth of Australia Council for Scientific and Industrial Research. Bulletin No. 45 A Soil Survey of the Woorinen Settlement, Swan Hill Irrigation District, Victoria By J K Taylor and F Penman Pp 41+4 plates. (Melbourne H J Green)

The Deeside Field Issued under the Auspices of the Deeside Field Club Fifth Number Edited by J B Philip Pp viii+92+32 plates. (Aberdeen The Rosemount Press) 3s. 6d

Transactions of the Fourth International Congress for Psychical Research, Athens, 1930 Edited by Theodore Besterman Pp 259. (London Society for Psychical Research)

FOREIGN

Sbornik Vysoké Školy Zemědělské v Brně (Bulletin de l Ecole supérieure d Agronomie Brno). Sign O18 Vliv paprskû ultrafialových na vzrůst a látkovou vyměnu ryb (The Influence of the Ultra violet Rays on the Growth and Metabolism of Fishes). Napsal Dr Boris Kostomarov Pp 55 Sign D16 Auximetry—Přírůstoměry Napsal Bohuslav Polanský Pp. 90 (Brno A Piša.)

Práce Moravské Přírodovědecké Společnosti (Acta Societatis Scientiarum Naturalium Moravicae), Brno Svazek (Tomus) 5, Spis (Fasciculus) 42 46, 1928-1929 Pp 415 (Brno A Piša) 100 Kč

Malayan Forest Records. No. 8 Durability of Malayan Timbers. By F W Foxworthy and H W Woolley with a Note on Termites, by H M Pendlebury Pp 60+6 plates (Kuala Lumpur Director of Forestry) 1 dollar 2s 6d

Maryland Geological Survey Vol 12 Pp. 336+16 plates Maryland Geological Survey Baltimore County Pp. 420+28 plates (Baltimore, Md Johns Hopkins Press)

Instituts scientifiques de Buitenzorg 's Lands Plantentuin Treubia recueil de travaux zoologiques hydrobiologiques et océanographiques. Vol 12, Livraison 2, Octobre Pp 121 261 (Buitenzorg Archipel Drukkerij) 2 50 f

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 5 No 5 November Pp. 973-1187 (Washington, D C Government Printing Office.)

CATALOGUES, ETC

Calendar for 1931 (Newcastle-on Tyne C A. Parsons and Co., Ltd)

Calendar for 1931 (London The *Chemical Trade Journal*)

Bericht über die Tätigkeit des Verlages Gustav Fischer in Jena in systematischer Übersicht C Naturwissenschaften (von Ende 1929 bis Ende 1930). Pp 82 Verzeichnis *naturwissenschaftlicher Werke* Botanik, Veröffentlichungen seit 1926 Pp 71 (Jena Gustav Fischer)

Books on all Technical Subjects and Applied Science, Second hand and New Pp 96 (London W and G Foyle, Ltd)

Diary of Societies.

FRIDAY, JANUARY 9

ROYAL GEOGRAPHICAL SOCIETY, at 8 30—Dr C M Yonge Life on the Great Barrier Reef (Christmas Lecture for Young People)

ROYAL SOCIETY OF ARTS (Indian Section), at 4 30

ROYAL ASTRONOMICAL SOCIETY at 5—Royal Observatory, Greenwich Mean Areas and Heliographic Latitudes of Sunspots in the Year 1929—A. H Wilson The Transmutation of Elements in Stars.—Dr W J S Lockyer A New Bright-hydrogen line Star of Spectral Type B8 in Lacerta.—General Discussion on Stellar Structure, opened by Prof E A. Milne, followed by Sir A. Eddington, Sir J H. Jeans, T Cowling, and others.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6—L. R. Cox New Lamellibranch Genera from the Tethyan Eocene—R. Winckworth (a) Growth of *Paphia undulosa* (b) Molluscan Fauna of Pulicat Lake.—Dr F Moll and Dr F Roch Teredidæ of the British Museum and the Jeffrey Collection

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6.15—A Dean and M M Macmaster Mercury Arc Rectifiers

INSTITUTION OF STRUCTURAL ENGINEERS (at Wolverhampton), at 6 30—E R. Knight Some Considerations affecting the Construction and Reconstruction of Bridges in Urban Areas

OIL AND COLOUR CHEMISTS' ASSOCIATION (jointly with Society of Chemical Industry Literary and Philosophical Society, and Society of Dyers and Colourists) (at Literary and Philosophical Society, Manchester), at 7—W O D Pierce Human Factors in Colour Judgments

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers Club, Manchester), at 7 15—J M Heyes The Design and Construction of Rayon (Artificial Silk) Machinery

INSTITUTE OF TRANSPORT (Newcastle-on Tyne and District Section) (at Y M C A Newcastle-on Tyne), at 7 30.—R W Lee Development of Road Passenger Services.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7 30.—C H. Faris The Application of Electro-deposited Metals to Engineering

JUNIOR INSTITUTION OF ENGINEERS, at 7 30—J Doonan Monel Metal Some Notes on its Production and Industrial Application

Geologists' Association (in Botany Theatre, University College), at 7 30.—Special General Meeting

Royal Society of Medicine (Ophthalmology Section), at 8.30 —N Fleming Flap Extraction —R. F Moore Bilateral Cataract from X ray Exposure

SATURDAY, January 10

Royal Institution of Great Britain, at 3 —Prof A. M. Tyndall The Electric Spark (6) Large Sparks (Juvenile Lectures).

MONDAY, January 12

Institution of Automobile Engineers (Birmingham Centre) (at Queen s Hotel, Birmingham), at 7 —F G Woollard Automobile Plant Depreciation and Replacement Problems.

Institution of Electrical Engineers (Informal Meeting), at 7 —J F Shipley and others Discussion on The Packing and Transport of Electrical and Allied Machinery

Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne), at 7 —C E R Bruce The Distribution of Energy liberated in an Oil Circuit Breaker with a contribution to the Study of the Arc Temperature

Illuminating Engineering Society (at British Commercial Gas Association, 28 Grosvenor Gardens), at 7 —E L Oughton Recent Developments in Gas Lighting.

Institute of Metals (Scottish Section) (at 39 Elmbank Crescent, Glasgow), at 7 30 —J G Roberts Chromium Plating

Chartered Surveyors Institution, at 8.—J E Drower St. Paul s (Lecture).

Royal Geographical Society, at 8 30 —Prof J W Thierry The Reclamation of the Zuider Zee

Institute of Brewing (London Section) (at Charing Cross Hotel).—J Stewart Malting Barleys of 1930

TUESDAY, January 13

Royal Astronomical Society, at 5 —Anniversary Meeting

Mineralogical Society, at 5 30 —Dr F C Phillips On a Soda margarite from the Postmasburg District, South Africa.—F A. Bannister (*a*) On the Distinction of Analcime from Leucite in Rocks by X ray Methods, (*b*) On a Chemical, Optical, and X ray Study of Nepheline and Kaliophilite (with Chemical Analyses by M H Hey)

Institution of Civil Engineers, at 6 —Prof A. H Gibson, T H Aspey, and F Tattersall Experiments on Siphon Spillways.

Institute of Marine Engineers, at 6 —J E Allan The Electrical Equipment of a Modern Ship

Society of Chemical Industry (Birmingham and Midland Section) (at Chamber of Commerce Birmingham), at 6.45.—E C Rossiter Resins derived from Urea and Thiourea

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7 —S. W Melsom, A N Arman and W Bibby Surge Investigations on Overhead Line and Cable Systems.

Institution of Heating and Ventilating Engineers (Associate Members' and Graduates Section) (at Borough Polytechnic), at 7 —J H Francis Concealed Floor Heating

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7 —R. Thorp Hot Water Heating

Royal Photographic Society of Great Britain, at 7 —W E Higham Featherland (Nature Film).

Institution of Automobile Engineers (Coventry Centre) (at King s Head Hotel, Coventry), at 7 30.—F G Woollard Automobile Plant Depreciation and Replacement Problems

Institute of Metals (North East Coast Section) (at Armstrong College, Newcastle upon Tyne), at 7 30 —N C Marples The Applications of High Nickel, Nickel Copper Alloys and Pure Nickel in Industry

Quekett Microscopical Club (at Medical Society of London), at 7 30 —W W Allen Pollination

Royal Anthropological Institute at 8 30.—W G Bateson Head Hunting on the Sepik River, New Guinea

Royal Society of Medicine (Psychiatry Section), at 8.30 —Dr Adler Paper

Pharmaceutical Society, at 8 30 —Dr E F Armstrong Thoughts from a Chemist s Garden (Lecture).

WEDNESDAY, January 14

Royal Society of Arts, at 3 —H Barnard Ancient and Modern Pottery (Dr Mann Juvenile Lectures) (2).

Geological Society of London, at 5.30.

Institution of Civil Engineers (Students Meeting), at 6.—I W G Freeman The Aerial Cableways at Nag Hammadi Barrage, Upper Egypt.

Television Society (at University College), at 7 —Short Papers on Television Progress in Europe and America during 1930

Institution of Electrical Engineers (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7 30.—Short Papers.

Institution of Chemical Engineers (at Chemical Society), at 8.—C F Hammond The Concentration of Phosphoric Acid Solutions by means of a Submerged Flame.

British Psychological Society (Medical Section) (at Medical Society of London), at 8 30 —Dr A Adler Paper

THURSDAY, January 15.

Royal Society, at 4 30 —Lord Rayleigh Iridescent Colours of Birds and Insects.—Prof O W Richardson and L. G Grimmett The Emission of Electrons under the Influence of Chemical Action at Lower Gas Pressures - E G Herbert The Hardening of Metals by Rotating Magnetic Fields.

London Mathematical Society (at Royal Astronomical Society), at 5.—U S. Haslam-Jones Note on Diophantine Approximation.—B. N Prasad On the Summability of Fourier Series and the Bounded Variation of Power Series.—M. R. Siddiqi: On the Theory of Non-linear Partial Differential Equations of Parabolic Type

Institution of Mining and Metallurgy (at Geological Society), at 5 30

Society of Chemical Industry (Bristol Section) (jointly with West of England and South Wales Oil and Greasemakers Association) (in Chemical Department, Bristol University), at 7 30.—W Kay Mineral Oils and Lubrication

North East Coast Institution of Engineers and Shipbuilders (Tees side Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30.—L Ripley Some Observations on Steel Founding

Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45

Chemical Society, at 8.—J W Baker Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group. Part I The Carbonyl Groups in Benzaldehyde and Acetophenone.—J W Baker and W G Moffitt Salt forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group Part II The Nitration of Benzaldehyde and Acetophenone in Sulphuric Acid Solution —L A Elson and Prof C. S Gibson 10-Chloro 5 10 dihydrophenarsazine and its Derivatives Part XIV Chloro-derivatives.—R. S Cahn, Prof C S Gibson, A. R Penfold, and Prof J L Simonsen The Essential Oil of *Backhousia angustifolia*. Part III The Constitutions of Angustione and Dehydroangustione

Royal Society of Tropical Medicine and Hygiene (at 11 Chandos Street, W), at 8 15 —Lieut. Col S P James Some General Results of a Study of Induced Malaria in England

British Institute of Radiology (at 32 Welbeck Street), at 8 30 —Dr J F Brailsford Hydatid Disease in England —Prof E. A Owen and H I Jones Ionisation Chambers for X Ray Dosage Measurement —Prof E. A Owen and Dr P Wright Physical Characteristics of the Scheidt Ultra Violet Ray Tube

Institute of Brewing (Yorkshire and North Eastern Section) (at Queen s Hotel, Leeds).—H M Chubb English Barleys of 1930 —T R Sutcliffe Foreign Barleys of 1930

FRIDAY, January 16.

Royal Society of Medicine (Balneology and Climatology Section) (Clinical Meeting at Red Cross Clinic for Rheumatism, Peto Place, N W 1), at 5

Physical Society (at Imperial College of Science), at 5 —S. Butterworth and S. D Smith The Equivalent Circuit of the Magnetostriction Oscillator —T L Ibbs and K E Grew The Influence of Low Temperatures on the Thermal Diffusion Effect.—Dr J H Vincent Further Experiments on Magnetostriction Oscillators at Radio Frequencies.—Dr L. C Martin The Theory of the Microscope

British Institute of Radiology (at 32 Welbeck Street), at 5 —Medical Meeting

Society of Chemical Industry (Liverpool Section) (at University, Liverpool), at 6 —Prof G T Morgan Organic Syntheses facilitated by Pressure (Hurter Memorial Lecture).

North-East Coast Institution of Engineers and Shipbuilders (at Mining Institute, Newcastle upon Tyne), at 6 —S. F Dorey Some Factors influencing the Sizes of Crankshafts for Double acting Diesel Engines.

Institution of Mechanical Engineers (Informal Meeting), at 7

Royal Photographic Society of Great Britain (Pictorial Group, Informal Meeting), at 7

Society of Chemical Industry (Newcastle Section) (at Armstrong College), at 7 30 —Dr B Moore The Use of Fused Silica in Science and Practice

Junior Institution of Engineers (Informal Meeting), at 7 30 —E W Willans Some Problems Surrounding the Reorganisation of an Engineering Works.

Royal Society of Medicine (Obstetrics and Gynæcology Section) (jointly with Tuberculosis Association), at 8 —Discussion The Management of Pregnancy, Parturition, and the Puerperium in Tuberculous Women. Openers Dr G Marshall and Dr M Hiley (Tuberculosis Association) A Bourne and L. C Rivett (Obstetrics and Gynæcology Section).

Society of Dyers and Colourists (London Section).—J T Holden Researches on the Laundering of Fabrics.

PUBLIC LECTURES

MONDAY, January 12

London School of Hygiene and Tropical Medicine (Public Health Division), at 3 —C N Hooper The Control of the Marketing of Fish —At 4 —C Hattersley Fish Inspection

WEDNESDAY, January 14.

London School of Hygiene and Tropical Medicine (Public Health Division), at 5 —Dr W G Savage Bovine Tuberculosis.

University College, at 5 —Dr J C Flugel Art, Pleasure, and Reality

Royal Anthropological Institute (at Portland Hall, Little Titchfield Street, W), at 5.30 —H A Stayt Coloured Peoples of the Union of South Africa.

Museum and Art Gallery, Belfast, at 8.—A Bertram How to Appreciate Pictures.

THURSDAY, January 15

University College, at 2.30 —Miss Margaret A Murray Egyptian History —Prof G Elliot Smith The Peking Man

FRIDAY, January 16.

University College, at 5 —G P Wells Comparative Physiology (Succeeding Lectures on Jan 23, 30, Feb. 6, 13, 20, 27, Mar. 6, 13, and 20)

SATURDAY, JANUARY 17, 1931

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No. 3194, VOL 127]

The Worth of Science

AT the nineteenth annual Conference of Educational Associations, held at University College, London, the president, Sir Richard Gregory, selected as the subject of his inaugural address "The Worth of Science" The address was no mere *catalogue raisonné* of the contributions of science to material progress and human comfort, no mere *addition* of the economic value of scientific discoveries In terms of billion and bullion only, no such evaluation is possible, for the liberation of life and intellect brought about by the work of the pioneers of scientific discovery is beyond price Galileo's classic words, *Eppur si muove*, helped to establish man's right "to think for himself in the realm of natural knowledge and to place personal observation above metaphysical and philosophical speculation and dogmatic assertion" Teachers may well be reminded of this debt to science, for without this spirit of freedom, "bequeathed from bleeding sire to son", their work would be degraded and the punishment reserved for them by Lucian, to sell kippers in the lower world, would be well deserved

Science has suffered some hard buffetings, especially in the United States, because the doctrine of evolution is supposed to be concerned with the obvious resemblances between men and monkeys and to envisage human progress in terms of "Nature, red in tooth and claw" But, as Sir Richard Gregory pointed out, evolution embodies the idea of social ethics, making the welfare of the community the essential purpose of the life of the individual If we study Nature we shall find abundant examples of ruthless cruelty, 'void and empty of every drachm of mercy", but we shall also find most beautiful examples of patience, co operation, self-sacrifice, and other virtues of which the human race cannot claim the patent

Finally, if it is fair to attempt such rapid summary of this admirable address, Sir Richard impressed the great lesson that science must not be blamed for the use to which its riches, its *cornucopia*, its bulging corn bins, are applied by the human race For more than a century chlorine had served a useful purpose as a disinfectant and a bleaching agent, before its use in warfare provided one of the greatest tragedies of the War If science offers to mankind a new earth, the question whether the new earth is better than the old depends on human will, on human judgment Science enables us to speak by wireless across the estranging ocean, but when the ethereal link is joined, have we anything

worth saying? Thomas Love Peacock remarks that civilised man admits he is unhappy anywhere and then congratulates himself on devising a machine which will transport him rapidly from one place where he is unhappy to another where he is not less unhappy

The wheel of life takes a full turn and, like the alarum clock which awakes us to another day's labour, science awakes us at intervals to a new world Galileo escaped with the comfortable punishment of being immured in his own study, but some of his contemporaries might have gone to the stake for the simple proposition that the earth goes round the sun After some centuries of intense study and research, the universe is still mysterious, more mysterious than to Galileo and his inquisitors, and if Einstein, Eddington, or Jeans were asked the simple question, "Does the earth go round the sun?" the answer, we suppose, would not be a plain yes or no Whatever that answer may be, however incomprehensible the mathematics used for its demonstration, there would be no *auto da fe*, no question of martyrdom *Eppur si muove*—though the modern world is able on occasion to devise subtle forms of persecution for the man of science

The impossibility of reaching finality is part of the lure of science, and, in a sense, of the "Worth of Science" Turning to medicine, Sir Richard Gregory said, with perhaps a *soupçon* of superiority, "When a savage is ill, he naturally attributes his sufferings to some enemy within him, and to witchcraft putting the enemy there" As regards certain diseases, that is apparently also the present view Dr H P Newsholme in his essay on certain aspects of encephalitis lethargica, entitled "Health, Disease, and Integration", attributes this disease in man to a lack of balance "within him" Owing possibly to some evil thought or memory, to some repression, the body cells begin to behave in a peculiar way Encephalitis lethargica has secured a new victim We must not exclude the possibility of learning from the untutored savage, though he may not have the hebdomadal privilege of reading NATURE The wise men of the east have wrested secrets from the book of Nature by the simple method of doing nothing, secrets which *Homo sapiens* of the west would not have discovered by fevered activity

Who shall point the way to the birthplace of Christ? Sir Richard Gregory did not evade this aspect of his subject He properly reminded us of Lessing's dilemma, the choice between truth and the impulse towards truth Leave the reality of absolute truth to its Creator and accept the impulse towards truth as the guide of life, and we shall be as happy as George Meredith's costermonger's donkey, going blithely along at a trot, merry in harness while we have to serve Happy—and humble too Is it not one of the greatest assets in the balance-sheet of science that it teaches those lessons of true humility which helped and comforted Bunyan's pilgrim on his weary progress?—

He that is humble ever shall
Have God to be his guide

T LL H

Man and his Universe

Man and his Universe By John Langdon Davies Pp xviii + 334 + 14 plates (London Harper and Bros, 1930) 16s net

THE author of this book has set forth in non technical language a series of pictures of man and the universe as seen by our primitive ancestors, by men of the Middle Ages, and by those who lived during the Renaissance, the Darwinian epoch, at the end of the nineteenth century, and finally in 1930 We may say at once that, when reconciled to the occasionally journalistic style, the reader can study the book with profit and interest We may criticise points of historical detail and feel unconvinced by some of the lessons the author draws from modern science, but we must admit that on the whole the work is well done, and that at all events it makes a good story

Mr Langdon Davies's main position is that science from one aspect is poetry (concealed by text books) and from another a search for God, in the course of which a series of new gods are discovered To explain the influence of science on religion, Mr Langdon-Davies quotes W K Clifford "The character of the emotion with which men contemplate the world, the temper in which they stand in the presence of the immensities and the eternities, must depend first of all on what they think the world is"

Mr Langdon-Davies is quite right in holding that, to understand our present outlook on life we must know something not only of savage superstitions and modern science, but something also of the thought of the intervening two thousand years He overlooks the earliest part of this time —the age of the pre-Aristotelian Greek philosophers, and also that of the first Christian synthesis of knowledge, which was predominantly Platonic and Augustinian He assumes that the influence of Aristotle was supreme throughout the

Dark and Middle Ages, and does not adequately appreciate the change in thought produced by the re-discovery of Aristotle's works by Europe in the thirteenth century Hence his medieval picture is true only of the time of the later centuries, when the characteristic thought of the Middle Ages was drawing towards its close, but of that period he gives a fair representation

The later Schoolmen, and especially Albertus Magnus and Thomas Aquinas, put together a new synthesis of knowledge, in which the science of Aristotle was combined with Christian dogma in a rational and consistent whole Hence, at the Renaissance, to attack Aristotle was to attack the Catholic faith, and innovators had to walk warily The Scholastic scheme regarded the earth as the centre and man as the meaning of creation, and the apprehension of God by the exercise of reason as the object of man The sublunary world was imperfect and subject to change, but the celestial spheres were faultless and unchangeable, spheres indeed because the sphere is the 'perfect' form—here again, let us note, is a survival of one of Plato's ideas

Ptolemy himself looked on his system of astronomy only as a mathematical exploration of the facts, and St Thomas regarded the geocentric view of the universe as a hypothesis, but less clear-sighted men took it as indubitable reality, both from the evidence of the senses and from Christian dogma Hence the Copernican system, when understood as a representation of fact, involved a true revolution in thought Mr Langdon Davies points out that Copernicus and Kepler were searching for mathematical harmonies and simplifications, but he misses the interesting connexion between their views and the Platonic and Pythagorean background, which survived beneath the predominant Aristotelianism of their day

Following mainly in the footsteps of Prof Burtt, Mr Langdon-Davies draws a contrast between the world of Aristotle and Aquinas and the world as it appeared when Galileo and Newton had done their work The first was a world essentially as it appears to the senses and was interpreted in human terms, a world of colour and form, of truth, beauty, and goodness—or perhaps their opposites In the second, the sole reality of the universe was matter in motion, regardless of human values, desires, or welfare Although Newton and his immediate followers still saw God in Nature, in the eighteenth century the philosophy developed from Newtonian science led through mechanism to materialism In the nineteenth, Lavoisier showed that matter was indestructible and unchangeable in amount, Dalton put the old atomic theory into modern guise, and Joule established the principle of the conservation of energy Finally Darwin and Wallace seemed to have brought man himself under the iron sway of 'natural law'

There seemed little more to learn and nothing much to do The whole of Nature appeared to point to determinism But, while nineteenth century science was reaching its climax, the new renaissance was coming into being Matter, which the plain man thought he understood as inert, solid lumps, was resolved into electric charges, sparsely scattered through the vast empty spaces of atoms, and radioactivity showed that some atoms at least are not eternal Quantum mechanics destroyed the idea of continuity, and the principle of uncertainty within the atom threw doubt on determinism as an ultimate character of Nature Finally, the principle of relativity showed that many things thought to be absolute depend on circumstances

Mr Langdon Davies has as much right as the rest of us to draw what conclusions in philosophy, religion, and morality seem to him to follow from these recent revelations The old orthodoxy and nineteenth century materialism are alike dead to him, and the chief consequences of the modern outlook on life are the removal of the sense of fear —fear of most of the evils of this world and of any other—and the passing away of the longing for immortality and of other age long desires which to him seem to be beyond our reach, if not meaningless Mr Langdon Davies will not expect us all to see eye to eye with him, but we can at least agree that the change produced in philosophic thought by the new scientific renaissance is and must be profound W C D D W

Science and Armaments

The Problem of the Twentieth Century a Study in International Relationships By David Davies Pp xvii + 795 (London Ernest Benn, Ltd, 1930) 21*s* net

MAJOR DAVID DAVIES has given us a very fine and weighty book It is an admirable illustration of the power of one definite idea, strongly held, to organise a great mass of knowledge and make it all subserve one supreme point This point to Major Davies is the need of an international police force to secure the obedience of the world to the dictates of the League of Nations It is not a new point, of course The French put it forward when the League was first started, and ever since

the critics of the League have been saying, "What can the League do to enforce its will, when it is faced by a recalcitrant Power, stronger than those, like Greece, Bulgaria, Jugoslavia, or Albania, with whom it has hitherto dealt? When a serious crisis arrives, will it not be defied and the world plunged again into anarchy and war, worse, no doubt, than we suffered in 1914–18?" It is because Major David Davies has felt so deeply the force of this argument and the horror of the prospect that he has been moved to write this eloquent and persuasive book.

The author assumes all the dangers of the present situation at their worst, and sets to work to plan a complete and watertight scheme to meet them. For, granting his premise and granting the feasibility of winning the assent of the Powers to it, nothing could be better thought out or fitted together than what he has given us. It is well worth the somewhat considerable time needed for reading nearly 800 large pages to see how he presses all the resources of literature and knowledge into the service of his cause. History in abundance, politics, statistics, even poetry, find a place. But how many people will be found to read the book, good as it is, or still less, to buy it? Every sincere sympathiser—and it may be predicted that anyone who gets through will sympathise—will join with this reviewer in an earnest wish that the author himself, or someone for him, will issue an abridged edition in a quarter of the volume, at a tenth of the price.

Major Davies's plan is simple and attractive. It has the great merit that every part of it has some foundation, either in the actual constitution of the world or of the League, or in the recent achievements of science and human thought. In the first place, there is to be what we might call an international General Staff, which would be recruited, as the Secretariat of the League now is, from all the signatory nations according to their weight. The principle of the 'barème', which is followed in assessing the contribution of the States Members of the League, is often invoked by Major Davies in this and other connexions. As the force is to be essentially of a police nature in regard to its duties, its chief would be called the High Constable, and this post might at first be held by a Frenchman, but only for a short period of years. Then there would be other constables at the head of the different sections—mechanical warfare, navy, air, and gas—into which the force would naturally be divided. But the central permanent staff would be but small, and arrangements would have to be made for speedily enlarging it at times of crisis by drafting into it the national quotas which all States members would train in their own countries, and which would be under their own control except when drafted into the international force.

In this matter Major Davies appears to us to show best his good judgment and his sense both of compromise and of the politically possible. It should be, he thinks, in the discretion of the national governments whether their quota should be sent for the particular service; but he looks to the growth of the community spirit, to the fact that the expenses would be borne by the community and that those who need protection themselves would be inclined to help in the protection of others, to secure that sufficient forces were always available to repress the aggressive or disturbing Power. But, in order to make concentration as quick and easy as possible, it is suggested that besides the headquarters, which might well be placed in Palestine, there should be unit bases of the international force all over the world. Strategic points and centres of existing international contact would be carefully chosen, such as Suez, Gibraltar, Panama, and it might always be made worth while for any Power, say the Turks in Constantinople, to allow a part of their territory to be used for this purpose, either by a substantial payment or by concessions elsewhere. Because—and this is one of the strongest two arguments in Major Davies's favour—he can count confidently on so large a saving in the general expenditure on armaments, that the world could afford to do well what he regards as the most necessary part of the whole. For it will be understood that it is as a step towards general disarmament that the scheme is planned. If the nations could gain a sense of security from the proposed international force, they would be content to let their domestic forces be cut down to a point of which the position of Germany under the Treaty of Versailles is the standing model.

We have left to the last what is perhaps the strongest, certainly the most impressive, of Major David Davies's arguments. It is the side which links up his case with science. He shows how the War was a turning point in the evolution of armaments, due to science; and that the process has gone on with increasing rapidity ever since. The air and gas are the two outstanding cases. One modern fighting aeroplane, we are told, could ward off and possibly put out of action a thousand aeroplanes of the pre-War or early War type; and the chemists go on making more and more deadly gases, in spite of several international undertak-

ings not to use any This appalling fact gives the author his most effective argument "Hand over", he says, "all those recent and future applications of science to warfare to your new international police force, and let domestic armies be content with pre-War armaments" Would that the nations would agree!

One feels at the end of this most suggestive book that it would prove as easy to persuade the world to turn all its swords into ploughshares as to adopt Major Davies's suggestions Meanwhile, let us labour incessantly to improve the existing machinery of the League and to carry out our existing obligations In this we shall have his support, no doubt, as he has our sympathy for his ingenious and further reaching scheme

F S MARVIN

Bacteriology

Medical Research Council A System of Bacteriology in relation to Medicine Vol 1 By F W Andrewes, J A Arkwright, J E Barnard, C H Browning, W Bulloch, H Chick, A D Gardner, A Harden, H McCombie, J W McLeod, E K Rideal, R St John Brooks, A Slator, H G Thornton Pp 374 + 18 plates (London H M Stationery Office, 1930) 21s net

IN Chapter I—"History of Bacteriology"—Prof Bulloch leads us from the ancient theories of epidemic disease and the discoveries of Leeuwenhoeck, through the work on spontaneous generation and many of the fascinating, though imperfect and often erroneous, results of some of the early investigators up to the brilliant work of Cohn, Pasteur, and Koch We are glad to read the high tribute given to the work of Cohn, who has been largely overshadowed by the man whom he discovered—Robert Koch The work of Pasteur, Koch, and many other brilliant investigators is given very fully, and the author finishes off with the history of the immunity doctrines Our only regret, in reading this chapter, is that much more space has not been given to Prof Bulloch We feel sure that this article will be read and re read many times by all ardent bacteriologists, not merely because it contains such a mass of interesting particulars, but also because of the style in which it has been written The illustrations are of supreme interest, and, might we add, we are glad to see in this volume many illustrations which are regretfully absent from the volumes which have been issued

The short chapter on morphology will prove of value, though we think the more bacteria and bacterial variation is studied, the less importance will be attached to morphology

In Chapter III Rideal deals with the physics of the bacterial cell and McCombie with bacterial pigments, while Chapter IV is concerned with growth and reproduction of bacteria A great deal of work has been summarised in these chapters, but the most interesting, and we think the most valuable parts, are those on cell division, colony formation, and spore formation, by Dr Gardner, and on the life cycle of bacteria, by Thornton The work of these authors makes us go back and re-read with greater interest and much more appreciation the work of the late Prof Löhnis

Chapter V, on the theory of disinfection, is of great interest, and quite well written There are many suggestive thoughts in it, but we consider its practical value somewhat limited We would have expected some information as to the action of common disinfectants on various types of bacteria In the section by C H Browning, which is very good, the selective action of the various dyes is emphasised, but this selective action is almost as well marked with the antiseptics in common use, so much so that the usual Rideal-Walker test for antiseptics is regarded by us as of very little value In a 'System' of this importance, so many omissions of points of practical value—unless a further chapter on disinfection is to appear in subsequent volumes—renders this chapter a very imperfect one

Chapter VI, on the metabolism of bacteria, by Arthur Harden, is such as one would expct from so distinguished a bio chemist It is very readable and should prove of considerable value to all scientific bacteriologists

Prof McLeod's work on the reducing action of bacteria, the production of peroxide and its bearing on anaerobiosis, has already taken a prominent place in bacteriological literature We expected in the chapter on bacterial respiration to have a paper somewhat unusual in character, of scientific interest and of practical value We have not been disappointed It is a chapter well worth careful study and thought

In Chapter VIII Sir Frederick Andrewes has undertaken an extremely difficult task Classification is needed, and to bring order out of the present chaos is a worthy ambition We have in this chapter a very accurate account of the various attempts, the successes, and the failures, and then we are given the criteria for classification—the morphology, cultural characters, etc The author concludes that "in any given case it is the sum of

the various characters which counts" After we have read the chapter, we feel that though the principles have been carefully demonstrated, we are to day no nearer an accepted and international classification or nomenclature than we were years ago We would like to have said more about "the marriage between Northern names and Latin terminations", but perhaps the polished language of the author is a better protest against these 'barbarisms' than our more vigorous language would have been

Chapter ix deals with variation In this chapter there is a great deal of new work, much of it based on the researches of the author The material is of very great importance, and the facts are all well put The general literature on this subject is very confusing, and we welcome the attempt—and we think the successful attempt—to make it clear The chapter requires careful and thoughtful reading, but it will well repay the time and labour spent on it

Taking this volume as a whole, it is the most interesting one yet issued, and, in itself, will give this 'System' a very high place in bacteriological literature J M BEATTIE

Biological Control of the Coconut Moth

The Coconut Moth in Fiji a History of its Control by means of Parasites By Dr J D Tothill, assisted by T H C Taylor and R W Paine Published for the Government of Fiji Pp vii + 269 (London The Imperial Bureau of Entomology, 1930) 31*s* 6*d* net

THIS sumptuously produced volume is in reality a detailed account of a single experiment in applied entomology It is concerned with the biological control of a species of moth the larva of which, in attacking the coconut palms of Fiji, threatened the copra industry of those islands with disaster The insect in question, *Levuana iridescens*, belongs to the family Zygænidæ and, so far as is known, is confined to Fiji Its larvæ, by destroying the foliage of the coconut, converted what were originally waving green fronds into remnants of miserable lifeless grey Since the insect proved to be free from parasitic enemies, this fact in itself suggested that its original home may be in some land other than Fiji It also appeared probable that the introduction, under favourable conditions, of some effective insect enemy might go a long way towards solving the problem of its control The present volume is a record of how this theory was translated into practice

Since a search among the Pacific islands for *Levuana* in its native home, where it would most likely be subject to attack by parasites, proved fruitless, recourse had to be made to allied coconut pests Insects of the family Zygænidæ are rarely destructive, but the species *Artona catoxantha* is known to attack coconuts in Malaysia and Java It proved, furthermore, to be subject to attack by the Tachinid fly *Ptychomyia remota* Since *Artona* and *Levuana* are closely related, it appeared probable that a parasite of the former genus would find the *Levuana* an acceptable host The campaign hinged on this possibility and, after considerable difficulties, the Tachinid fly was eventually introduced into Fiji The success of the experiment was remarkable six months after its introduction, the fly had spread throughout the areas of Fiji affected by the *Levuana*, and many of the outbreaks had subsided entirely owing to the destructive effects of this parasite upon the caterpillars of the moth There has, to-day, been no outbreak of the pest for more than three years, and the copra industry of Fiji has been extricated from an awkward predicament by this fortunate biological experiment

The history of the campaign is described in detail in this volume the structure and life-history of the moth are elaborately dealt with and the parasitic *Ptychomyia* is similarly discussed Allied Zygænid moths and their natural control also come in for treatment, and there is a wealth of text-figures and beautifully executed coloured and half-tone plates appended The whole volume thus serves as a detailed permanent record of an experiment of equal importance to those achieved in Hawaii and elsewhere No similar biological triumph has so far been placed upon record in so complete and elaborate a form The high price of the volume may militate against its rapid circulation, but all whose business is concerned with pest control will need to add it to their bookshelves It should prove a valuable propagandist source in that it will focus attention upon the possibilities of biological control—when it is applied intelligently to problems amenable to this method of solution

A number of entomologists, administrators, and others have played their part in the campaign recorded To each of these we tender our sincere congratulations upon an achievement that should rank high in the annals of applied entomology The Imperial Bureau of Entomology, which published the volume on behalf of the Fiji Government also deserves commendation for the faultless style in which it has been produced A D IMMS

Our Bookshelf.

Lord Balfour in his Relation to Science By Lord Rayleigh Pp viii + 46 (Cambridge At the University Press, 1930) 2*s* 6*d* net

FOLLOWING the death of the Earl of Balfour, F R S , Chancellor of the University of Cambridge, which occurred on Mar 19 last, an obituary notice by his kinsman, Lord Rayleigh, was published in the *Proceedings of the Royal Society* This memoir was limited to an account of Lord Balfour's early history and mental development, his scientific and philosophical thought, and his administrative work for scientific, industrial, and medical research Quite justifiably it was soon realised that, beyond strictly scientific circles, there was an interested public desirous of knowing about those very matters detailed therein, their kind and substance Accordingly, the memoir has been republished, with a photograph as frontispiece

In all probability the public referred to would have welcomed more about this many-sided personality in fields of knowledge and inquiry which embraced science The earlier part of the memoir recalls Balfour's upbringing, and the springs of scientific interests which welled up in the family brotherhood and sisterhood and immediate connexions As regards the latter, Lord Salisbury, sometime Prime Minister, was Balfour's uncle, Lord Rayleigh (father of the writer of the memoir), his brother-in-law We are told that throughout his life Balfour had the highest admiration for Darwin, "because", he said, "he was not a partisan—he really wanted to find out the truth—an attitude of mind seldom found among men of science, and never among theologians" Rather contrariwise, an extract from Lady Rayleigh's journal, June 16, 1892, records that "Paderewski was at the Royal Society soirée last night, and in discussing it Arthur remarked of the scientific guests, 'They are the people who are changing the world and they don't know it Politicians are but the fly on the wheel—the men of science are the motive power'"

Throughout this study no passing allusion is made to Lord Kelvin, yet contact with Balfour must have been close and cordial, and fraught with inherent interest He was, in fact, president of the Royal Society at the date of the soiree mentioned above

State of Arkansas Arkansas Geological Survey Bulletin 3 *Geology of the Arkansas Paleozoic Area, with especial reference to Oil and Gas Possibilities* By Carey Croneis Pp xx + 457 + 45 plates (Little Rock, Ark Arkansas Geological Survey, 1930)

THE area covered by this work is some 25,000 square miles in the central, northern, western, and north western parts of the State of Arkansas, constituting the highlands and embracing the well-known physiographic elements the Ozark Plateau, the Arkansas River Valley, and the Ouachita Mountains The volume is of interest to geologists generally because of the good account of the different palæozoic faunas given, an account enhanced in value by the excellent illustrations of the characteristic fossils In fact, the illustrations as a whole are such a conspicuous feature that they may almost be said to make the book Certainly, some of them depicting field-features would adorn many a well recommended text book of physical geology, and it is a pity that they are comparatively lost in a State survey memoir

With regard to oil and gas possibilities, the Ouachita Province is regarded as unfavourable, the Arkansas Valley implies for the most part dry gas resources, and the southern part of the Ozark highland has a slight chance of oil production There is a sidelight on the applicability of the carbon ratio theory in connexion with the gas prospects, some of the ratios of the Carboniferous coals are so high as eighty eight, which should rule out any possible existence of gas fields, these ratios, in point of fact, are without significance, since some of the largest producing gas fields are located in such terrain

This is a readable memoir It gives a clear impression of the pure and economic geology (in so far as oil and gas are concerned) of a vastly interesting region, and in style and presentation breaks away from the more monotonous conventions of the national survey There are two maps included, both tectonic, one depicting structural axes of the Arkansas Valley and Ozark Provinces, the other, axes of the Ouachita Mountain Province

H B M

Sedimentary Petrography with Special Reference to Petrographic Methods of Correlation of Strata and to Subsurface Oil Geology By Henry B Milner Second (revised and complete) edition Pp xxi + 514 + 40 plates (London Thomas Murby and Co , New York D Van Nostrand Co , 1929) 21*s* net

MILNER'S "Sedimentary Petrography" is essentially a laboratory manual and text-book It incorporates two previously published works by the same author—"An Introduction to Sedimentary Petrography" and "Supplement to an Introduction to Sedimentary Petrography"

In the new volume the author's aim has been to provide a comprehensive text-book of the petrology of all types of sediments, consolidated as well as incoherent Not only, therefore, is the text of the earlier volumes amplified and brought up-to date, but also much entirely new matter has been added Chief among this is a lengthy chapter on the petrography of the consolidated sediments, that is, limestones, shales, etc , as opposed to loose sands In another new chapter the author discusses at some length the desirability of the employment in the study of soils of the methods of examination of sedimentary rocks dealt with earlier in the text

The whole bias of the book is admittedly towards the examination of sedimentary rocks by study of their 'heavy residue' content, with emphasis on the economic applications of the results obtainable Commendable features are the numerous diagrams and plates, and the large

number of references in the text to original papers There is also an extensive bibliography

The practical study of sedimentary rocks has been much to the fore in recent years To all interested, whether from a scientific point of view, as oilfield geologists, or as soil mineralogists, this manual should prove invaluable

Production Conditions, Organisation and Results of Czechoslovak Farming Edited by Dr Vladislav Brdlík Part II Pp 242 + 79 (Prague State Agricultural Institute, 1930) 24*s*

AN elaboration of statistical material touching the production and yield conditions in Czechoslovakian agriculture is set forth in this volume The material is based on returns from 1652 farms for the years 1909–1913, and contains, on one hand, deductions from the statistical material published in Part I with comparisons from a territorial point of view, and on the other hand, a critical consideration of the data from the point of view of representative investigations The question brings into relief the changes in the organisation of farms and the results of their workings in the case of transition from the intensive and highly developed western methods to the extensive system as now practised in Czechoslovakia The deductions arrived at from the various points of view form a basis for measures of practical and economic policy (for example, customs, finance) and for scientific purposes, and so on The published material also has a historical significance, for it shows farming conditions as they existed before the great changes produced by the War The data, as worked up, provide a basis for various economic calculations, as they represent stabilised and normal relations both in regard to prices and methods of farming, and the method of presentation makes it possible to use the material in the case of changing price conditions It is claimed that this published statistical material will remain a basic and firm starting-point for the study of what is translated as the " dynamic economic phenomena"

For convenience of reference the critical examination of the data by Dr Stanislav Kohn is given in French and German as well as Czech, similar treatment being given to the introduction, chapter headings, and certain tables

Chinese Civilization By Prof Marcel Granet Translated by Kathleen E Innes and Mabel R Brailsford (The History of Civilization Series) Pp xxiii + 444 + 12 plates (London Kegan Paul and Co , Ltd , New York Alfred A Knopf, 1930) 25*s* net

DR GRANET's study of Chinese civilisation ranges from the beginnings as set forth in the traditional account of the Tsu-King down to the end of the second Han dynasty in the early years of the third century A D It falls into two parts In the first the political history is briefly surveyed In the second the constitution and development of Chinese society is reconstructed M Granet deals critically with the traditional history and shows it to be an ideal projected into the past by antiquarian reconstruction and remodelling of the materials Up to the present the auxiliary studies of ethnology and archæology have thrown little light on the problems of tradition, and M Granet constantly emphasises the need for excavation At the same time, he is prepared to put it forward as a working hypothesis that Chinese civilisation is to be explained by the contact of two principal civilisations, one a civilisation of terraces and millet, and the other a civilisation of rice and the low lying plains M Shirokogorov's investigations of the physical anthropology of Northern China would appear to support this view

In his second part, in dealing with Chinese society M Granet accepts tradition, but interprets it by a correlation with the evidence of the historic periods This makes possible a reconstruction beginning with the initial organisation among the peasant families and rural communities of the plains, passing on to the foundation of the chieftainships and the seignoral towns, and ending with the state of society at the beginning of the empire Here M Granet's work is a brilliant piece of interpretation

Birth Control on Trial By Lella Secor Florence Pp 160 (London George Allen and Unwin, Ltd , 1930) 5*s* net

THE enthusiastic claims of the contraceptive literature of a few years ago have now given way to a general impression that there is no satisfactory method of preventing pregnancy This is confirmed by an investigation undertaken by Mrs L S Florence at the Cambridge Birth Control Clinic, and now published under the title of " Birth Control on Trial " Her conclusion that such methods as can be recommended are too complicated and unreliable is fully justified Every doctor sees occasional patients whom he must warn to avoid pregnancy, and to such warning there ought to be added some instruction concerning methods There is obviously a demand for research into this subject, which can only be undertaken by the medical profession The book is not intended to hold a brief for the ethics of birth control, but some of the case-histories it contains are sufficiently tragic to shake the convictions of the most confirmed opponent of contraception

General Practice (Some further Experiences) By Dr Ernest Ward Pp iv + 108 (London John Bale, Sons and Danielsson, Ltd , 1930) 3*s* 6*d* net

DR ERNEST WARD's second book on the joys and troubles of general practice is as entertaining as his former " Medical Adventure ", in which were described clinical, obstetric, and pathological experiences The present volume is devoted to the other side of a practitioner's life, and covers a wide range of subjects, from where and how to secure a practice to when and whom to marry The chapters on the arrangement of the day's work, and the attitude of the doctor to his patients, his colleagues, and unorthodox treatment, are particularly good The author disclaims any intention of giving advice, but every page contains the equivalent of years of experience The book is sure to be of interest to every medical man

Letters to the Editor.

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Stellar Structure

IN NATURE of Jan 3, Prof Milne writes that my theory of stellar structure accounts for the existence of giant, dwarf, and white dwarf stars, " only at the cost of *ad hoc* hypotheses quite outside physics It assumes stars to contain atoms of atomic weight higher than that observed on earth, and it assumes them to be relentlessly disappearing in the form of radiation, it appeals to discontinuous changes of state consequent on successive ionisations, for which there is little warrant "

This seems to me a mass of highly concentrated inaccuracy My actual hypotheses are that the stars we observe in the sky must be stable and need not be gaseous, it seems odd to describe these as " *ad hoc* hypotheses quite outside physics " What Milne describes as " assumptions " are inferences after the main results have been obtained After the Russell diagram has been obtained an atomic number of 95 seems to give the *best* fit with observation, but I could have " assumed " a far lower number and obtained quite a *good* fit Incidentally, no other theory gives any fit at all—or even anything to fit The appeal " to discontinuous changes of state " appears to be a highly coloured description of the fact that I find that bands of stability and instability alternate

I find it hard to believe that other astronomers understand my theory as little as does Prof Milne If they do, he is no doubt right in saying that the majority do not accept it

I am not writing to challenge Milne's inaccuracies so much as to ask whether his new theory must not ultimately prove identical with my own theory, which " the majority of astronomers do not accept " We start out on the same road, by not seeing eye to eye with Sir Arthur Eddington Milne's recent discoveries—that mass and luminosity are independent, that the mass luminosity relation is a happy (or unhappy) accident, etc —are merely old familiar landmarks on a road which I travelled and described fully in NATURE and *Mon Not R A S* more than ten years ago

Milne and I part company on the question of stellar boundary conditions The classical Emden solution starts with a finite density at the star's centre and integrates outwards Eddington, and then I, followed Emden in thinking that Nature was bound to look after the boundary conditions somehow or other Then I noticed (" Astronomy and Cosmogony ", §§ 80, 81) that what appears to be a single solution in a star's interior, spreads out into a whole tassel near the photosphere, it proves to be merely an asymptote to a whole family of solutions which correspond to different boundary conditions This shows that any boundary condition can be satisfied, so that " the influence of the special conditions which prevail at the surface soon disappears as we pass inwards into the star " (l c § 80)

This fundamental point can be illustrated by a simple model suggested by Milne (*M N*, **90**, p 53) Represent a star by a sphere of copper s with a heating coil at its centre, and its photospheric layers by s', a thin coat of asbestos, paint, or other substance Varying the substance of s' represents varying the photospheric conditions of a star, we want to find how interior conditions depend on s' Milne solves the problem wrongly, as I think, and concludes that the sphere coated with asbestos will be " much hotter inside " than one wholly of copper, " for it is jacketed by a bad conductor " As every plumber knows, this is not so, only a thick layer of asbestos will make things much hotter inside It is, I think, the same with the stars Whatever the photospheric conditions, the photospheric layers are not thick enough to make any real difference

Thus Milne's involved procedure of integrating inwards, getting infinite or zero density, and then letting masses of unsupported gas crash to finite densities seems to me all unnecessary, he could have assumed a finite central density to begin with and integrated outwards, and as this is the exact procedure followed in my theory I cannot see how our final results can be different—unless one of us makes a mistake in analysis or arithmetic

It is, of course, also the procedure followed by Eddington in his classic papers Where I differ from Eddington is not on general questions of procedure, it is that he thinks a star's centre must be gaseous, whereas I do not Also, we differ as to whether his very restricted model with $\kappa\eta$ constant is a very good or a very bad model Milne appears to have followed Eddington so far in tying himself down to this particular restriction Unless I am greatly mistaken, all that is essentially novel in his theory (as shown in Figs 1 and 2 in his NATURE article) will vanish to nothing as soon as he frees himself from this impossible and misleading restriction

J H JEANS

Cleveland Lodge, Dorking,
Jan 5

Aurora Display and Magnetic Disturbance

ON Saturday evening, Dec 20, at about 18 h 35 m, I noticed that the sky was strongly illuminated along the northern horizon, the light extending about 40° in azimuth, with its centre, as near as could be estimated from the position of the pole star, true north, and a maximum altitude of about 15° It was at once suspected as an auroral arch, but as the magnetic curves which had come off that morning showed the magnetic conditions to be exceptionally quiet, some doubt was felt as to the auroral character of the light A suspicion was entertained that it might be due to the illumination of a sheet of very high cloud, though the sun was far below the horizon This, however, appeared unlikely, both from the length of time after sunset and from the fact that there was no illumination over the western or north western horizon

The light was kept under observation, and was very steady, with no indications of streamers, though once or twice there was a suspicion of a flicker higher up in the sky At about 18 h 50 m the light began to fade out, commencing at the eastern end of the display, and at 18 h 55 m the last traces at the western end had disappeared

That this phenomenon was an auroral display is confirmed by the magnetic curves which came off on the morning of Dec 22, which show that a quite notable magnetic disturbance was in progress at the time

The magnets began to be slightly disturbed at about 16 h, a 'bay' forming in the declination trace, centred at about 17 h 10 m and the horizontal force falling to a minimum at 17 h The most notable feature of the disturbance was the fall in value of the declination from a maximum at 18 h 2 m, to a minimum at 18 h 53 m through a range of 39′ The major

portion of this fall occurred at a practically uniform rate between 18 h 28 m and 18 h. 53 m, during which interval the range was 31′, followed by a sharp rise of 18′

The chief feature of interest in this observation is that the auroral light persisted whilst the declination value was falling rapidly, and ceased at practically the same moment as that fall ceased There is some doubt as to the exact moment when the auroral light ceased to be visible It was certainly not later than 18 h 55 m, but it may have been from one to two minutes earlier

Now if the aurora and magnetic disturbance be attributed to a stream of ionised particles emanating from the sun and reaching the earth's upper atmosphere, consideration of the above conditions enables us to assign the nature of the charge carried by the particles For such a stream would, in the northern hemisphere, be proceeding from lower to higher latitudes, and descending earthwards in the vicinity of the pole, and considering such a stream as equivalent to an electric current, the application of Clerk Maxwell's 'corkscrew' rule shows that to produce a diminution of the westerly component of the earth's magnetic field (a decrease of westerly declination), the charge carried by the particles must be negative

When the stream ceased, it would be expected that both the ionisation of the upper atmosphere, causing the auroral light, and the magnetic deflecting force would cease at about the same time That the light should have first faded out at the eastern edge, and persisted longest at the western, remains unexplained

It is worth noting that this magnetic disturbance, though not very large, is one of an unbroken sequence at approximately 27 days' interval, persisting since December 1929 The eruption on the sun observed with the spectrohelioscope at Greenwich on Nov 25, as noted in NATURE of Dec 20, occurred about a day after the commencement of the November member of the series

The disturbances of this sequence have commenced throughout with the passage of solar longitudes 120° to 150° over the central meridian of the visible disc, and have lasted for 8 to 10 days, coming to an end with the meridian passage of solar longitude about 30°, thus indicating exceptional activity over the sun's surface between these longitudes throughout the year

J P ROWLAND, *S J*

Stonyhurst College Observatory,
Nr Blackburn,
Dec 23

The Latent Splitting of Bars undergoing Transverse Vibrations

THE formation of slip bands in bodies subjected to different kinds of stresses has been studied by several observers These have been regarded as dependent on the crystalline nature of the materials More recently A Nadal [1] has given an interesting account of his experiments with marble, paraffin, and several metals, illustrated with numerous photographs

While studying the variation of Young's moduli of materials under low stresses by a method similar to the one described by me,[2] it was noticed that considerable fluctuations occurred in the frequency of a fixed length of a bar when observations were taken over a long period of time These could not be ascribed to any sources of error Further, it was also observed that these distinct frequencies did not vary in any continuous manner, but that certain definite values repeated themselves when a large number of observations was taken For many purposes these fluctuations are usually ignored and a mean value of the frequency determined for a given length of the vibrating bar The observations reported here, however, leave no room for doubt, as others have also pointed out, that a vibrating bar clamped at one end is not a constant source of frequency at all What these fluctuations in reality signify is the purpose of this note to suggest

These fluctuations in frequency can be explained on the assumption that the experimental bar is in reality made up of a number of thinner strips of nearly equal thicknesses coupled together by cohesive forces It has been then found possible to work out a relation between the thicknesses of the component strips of the bar and the distinct frequencies into which the bar as a whole vibrates from time to time—the frequencies generated being the result of the action and reaction of the component parts on each other

If t_1, t_2, t_3, etc, be the thicknesses of the component strips of a bar of total thickness d, so that

$$d = t_1 + t_2 + t_3 + \quad t_N,$$

where N is finite and small, and if n_1, n_2, n_3, etc, be the distinct frequencies of the bar as a whole, it can be shown that

$$\frac{t_1}{t_1 + t_2 + \quad t_N} = \frac{n_1}{n_1 + n_2 + \quad n_N}$$

or $$t_1 = \frac{d\ n_1}{n_1 + n_2 + \ .\quad n_N},$$

and $$t_2 = \frac{d\ n_2}{n_1 + n_2 + \quad n_N},\quad t_3 = \text{etc}$$

Since d, n_1, n_2, etc, are all measured directly, we have here a method of calculating the thickness of the component strips into which the bar, although sound to all appearances, really splits In support of this view of the phenomenon, it is interesting to point out that the actual lines of ruptures, separated by distances exactly predicted from the above theory, have been observed and measured in a large variety of substances under a microscope These rupture lines are very sharp and run parallel to the surface of the bar perpendicular to the plane of its bending The agreement between the calculated and observed values of t's is remarkably good The substances examined so far include, among others, copper, steel, aluminium, marble, slate, and different kinds of wood All these materials show the effect described above very clearly In view of the general nature of the phenomenon common to such different substances as wood and metal, and also in consequence of the fruitfulness of the idea that the experimental bar can be looked upon as made up of a discrete number of thinner bars held cohesively together, it is here suggested that 'latent splitting' is a more appropriate name for the effects observed than formation of 'slip-bands', which seem to refer to crystalline substances in particular

Since the t's and their differences for any material must be an integral number of times the thickness of its ultimate component parts, an interesting application of the theory sketched above leads, with the power of the apparatus used in the present investigations, to a determination in the case of

(*a*) Wood—of the mean diameter of its fibres

(*b*) Metals and stones—of the thicknesses of crystal grains or distances between cleavage planes which are exact multiples of the lattice cell constant as given by X ray analysis Full details of theory and experiments will be published shortly in a paper

in preparation Only a few typical results are given here

Material	t from theory in cm	t from obs in cm	Mean diameter of fibres from theory in cm	Fibre diameter directly measured in cm
Boxwood	0·0746 0 0759 0·053, 0 051	0 075 0 055	6 55 × 10⁻⁴	6 58 × 10⁻⁴
Copper	0 0338 0·0338 0 0449, 0·0665	0 033 0·045, 0 070	The thickness of grain deduced = 906 24 × 10⁻⁸ cm and this is 251 × 3·610 A, where 3 610 A is the value from X ray measurement	
Slate	0·0442, 0 042 0·0381, 0 0370	0 045, 0 040 0 038, 0 037	The thickness of grain deduced = 605 54 × 10⁻⁸ cm and this is 200 × 3 027 A, where 3 02 A is the value from X ray measurement	

The wood fibres were prepared by the Schulze process, and their mean diameters were measured directly under a microscope

K PROSAD

Physics Department, Science College,
Patna, India, Nov 21

[1] *Zeits tech Physik*, 5, 9, pp 369-378
[2] *Phil Mag*, vol 7, p 548 March 1929

Systems of Four Immiscible Liquid Layers

SYSTEMS of three immiscible layers are sufficiently uncommon to be noteworthy, and no system of four layers appears to have been described (excluding systems containing free mercury) Nor is this remarkable when it is recalled, first, that practically all *dry* organic liquids are completely miscible, almost the only exceptions being polyhydric alcohols, secondly, that a system of four liquid phases requires the existence of four substances or solutions, which taken three at a time yield at a fixed temperature four systems each of three liquid phases, the immiscibility of which is in no case destroyed on saturation with the fourth component The majority of the hitherto described systems of three liquid phases (of which the system water–aniline–hexane is typical) owe their existence to the properties of a substance such as aniline or succinic nitrile, which is not completely miscible with water, but itself absorbs sufficient water to destroy its miscibility with another solvent, such as hexane or carbon disulphide, which absorbs only traces of water

A study of systems containing soaps revealed a different type of three-layer system When an electrolyte is added to an aqueous soap solution in equilibrium with an organic solvent not completely miscible with it (or when the soap concentration is increased beyond a certain limit), one of three things may happen

(1) The soap is salted out as solid curd

(2) The soap is transferred completely to the solvent layer

(3) The salted-out soap absorbs water and solvent to form a third layer immiscible with either lye or solvent

The system sodium oleate, sodium chloride, ethyl acetate, water, illustrates all three possibilities the first, for example, at 25°, the second at 55° for high salt concentrations, the third for lower salt concentrations at the same temperature These three layer systems differ from the type previously mentioned in that two of the layers are predominantly aqueous in composition Since such systems can be prepared using either aniline or hexane as the solvent, and since wet aniline, hexane, and water are mutually immiscible, the conditions are fulfilled for a system of four liquid layers, provided the presence of soap in at least three of them does not destroy their immiscibility Suitable proportions do, in fact, yield a four phase system at room temperatures, this is most easily prepared by mixing the organic liquids and oleic acid (which are miscible in the absence of water), and adding sufficient aqueous sodium hydroxide to saponify the fatty acid and salt out the soap The following proportions yield approximately equal volumes of the four layers

Hexane (or light petroleum)	12 c c
Aniline	7 c c
Oleic Acid	0 5 c c
Alcohol	1 5 c c
Aqueous Sodium Hydroxide – 0 8N	10 c c

The alcohol is not essential to the system, but reduces the time required for separation of the layers from hours to minutes An increase of temperature or of electrolyte concentration renders miscible the hexane and aniline layers (first and third from the top), which then form the top layer

This four-phase system contains five components (excluding the alcohol), which is one more than the minimum required by the phase rule Although both aniline and hexane could probably be replaced by other liquids, there seems to be no possibility of producing a four phase system of this type with only four components

It need scarcely be added that the addition of mercury gives a five layer system—a unique scientific curiosity

E LESTER SMITH

Research Laboratory,
Chelsea Polytechnic, S W 3,
Dec 9

The Longitudinal Distribution of Photoelectrons

FORMULÆ of the type

$$P(\theta)d\theta \propto (A + B\cos\theta)\sin^3\theta d\theta \qquad (1)$$

as a first approximation to more complex forms have been proposed as illustrating the existence of longitudinal asymmetry in the spatial distribution of photoelectrons [1] Here $P(\theta)d\theta$ is the probability of photoelectric emission between angles θ and $(\theta + d\theta)$ to the ray, A is usually unity and B some function of the frequency of the incident radiation and of the atomic number of the atoms upon which the radiation falls The angle of bipartition θ_b is then obtained from the relation

$$\int_0^{\theta_b}(A + B\cos\theta)\sin^3\theta d\theta = \int_{\theta_b}^{\pi}(A + B\cos\theta)\sin^3\theta d\theta \qquad (2)$$

and the average forward momentum

$$\overline{mv\cos\theta} = mv\int_0^{\pi}(A + B\cos\theta)\sin^3\theta\cos\theta d\theta \Big/ \int_0^{\pi}(A + B\cos\theta)\sin^3\theta d\theta \qquad (3)$$

I should like to point out that from another point of view the distribution formula (1) does not give the information concerning θ_b and $\overline{mv\cos\theta}$ that is ascribed to it A similar expression can be built up from quite simple principles, which, however, preclude us from performing any integration outside the limits 0 to $\pi/2$

Assuming the wave mechanical principle of interference $P(\theta) \propto \sin^2\theta$ and that independent groups of photoelectrons originate from a small plane circular area of radius b normal to the ray and a small spherical volume of radius a respectively, situated at the origin, we could write down at once the whole probability

$$P(\theta)d\theta \propto (A'\pi a^2 + B'\pi b^2\cos\theta)\sin^3\theta d\theta \qquad (4)$$

where A' and B' are factors independent of θ

From the way in which the problem is stated and because of the inclusion of the cosine term involving

negative probabilities, expression (4) must be regarded as unilateral and integrable only between the limits 0 to $\pi/2$ If the other half of the spherical aperture surrounding the origin is to be considered, the ray must be reversed Everything would then be symmetrical about the plane $\theta=\pi/2$, there would be no justification in drawing any other conclusions with regard to θ_s or to the average forward momentum Of course, if equation (4) is integrated as in (2) and (3) it will yield results which are obviously fictitious

That longitudinal asymmetry exists has been abundantly shown by experiment It is introduced in the Compton effect, and it is apparent that the probability of the interaction between a photon and an electron must depend on some mutual directional relationship existing between the two during the period of interaction LEWIS SIMONS

Birkbeck College, London, E C 4,
Dec 1

[1] Sommerfeld Wave Mechanics p 187, 1930 G Schur *Ann d Physik* **4**, p 441, 1930 See also Carrelli, NATURE, June 1, 1929, and E J Williams, NATURE, April 13 1929

Part-Absorption Phenomena of X-Rays

IN connexion with the partly absorbed lines observed by Ray (NATURE, May 17, p 746, June 7, p 856, Sept 13, 1930, p 399), I have observed the following lines, using similar arrangements

Incident Radiation	Absorbing Substance	Modified Lines	Origin
Fe$K\alpha_{1,2}$ (471 0)	C	2022 X U (450 6)	Fe$K\alpha_{1,2}$ – C$K\alpha$ (20 4)
,,	N	2053 X U (443 8)	Fe$K\alpha_{1,2}$ – N$K\alpha$ (27 2)
,,	Al	1975 X U (461 4)	Fe$K\alpha_{1,2}$ – AlL_1 (9 6)
Fe$K\beta_1$ (519 9)	,,	1784 X U (510 8)	Fe$K\beta_1$ – AlL_1 (9 1)
Ni$K\alpha_{1,2}$ (550 0)	,,	1688 X U (540 0)	Ni$K\alpha_{1,2}$ – AlL_1 (10 0)

The figures in the bracket indicate the values of ν/R

A current of 7 ma was passed through the X ray tube at a peak voltage of 24 kv The transmitted beam was analysed by a calcite crystal

The appearance of the lines with aluminium as the absorbing substance is rather interesting Though the actual value of AlL_1 is not known, the theoretical value obtained by Mukherjee and Ray (*Zeit f Phys*, vol 57) is 9 2 (ν/R) As yet I have not observed any line having $K\alpha_{1,2}$ – AlL_2 as origin This seems to be in accordance with the observations of Robinson, who found that if the energy of the incident quanta is large when compared with those of L levels, the L_1 absorption edge has a much greater intensity than that of L_2

The partly absorbed lines are diffuse and have a definite breadth, and as such they can be selected from known faint lines The breadth of the lines, when measured in volts, approximates to the ionisation potential of the atom in question, and thus points to the fact that the electron, which is lifted from the original level to the periphery or to any other optical level by the part absorption of the radiation, is not removed from the atom completely

In this connexion it may be pointed out that as the partly absorbed lines are very weak and diffuse, great precautions were taken to reduce the blackening of the plate from the general radiations, especially from higher orders, as much as possible, by decreasing the voltage and increasing the current through the X-ray tube Further, by varying the thickness of the absorbing layer and the time of exposure, a condition was found where the best photographs were obtained in about 8 hours Agfa Röntgen films are more suitable for this type of work than ordinary plates R C MAJUMDAR,

Department of Physics,
University College of Science,
Calcutta, Nov 19.

The Equivalence of the Valencies of Carbon

I POINTED out some time ago,[1] that despite Pasteur's original statement, or at all events, the text book version of it, optical enantiomers were possibly not completely identical I followed this up with an investigation of the rotatory powers of the mandelic acids,[2] in which at least preliminary evidence of non identity was obtained I am about to publish an account of a lengthy investigation of the camphoric acids, in which differences of the same kind have been observed

In the paper to the Faraday Society (loc cit) I pointed out that a probable consequence of the non identity of enantiomers would be that, in the language of the tetrahedral conception, the carbon valencies were not symmetrically distributed in space, and that, therefore, numerous unsuspected isomers, differing only slightly in physical properties, should exist It therefore behoved us to investigate anew the properties of such bodies as methylene chloride, bromide, and iodide, the supposed non-existence of isomers of which was formerly adduced as evidence in favour of the tetrahedral, as opposed to the plane, distribution of the carbon valencies I am, of course, not contending for a plane distribution of valencies It is of interest that my suggestion of alternative orbits for an electron in the same atom has been brought forward independently as an explanation of the existence of 'electro-isomers'

As a preliminary to commencing work upon the methylene halides, I read through the literature on the subject, or at least such of it as is accessible to me here, and I was surprised to find that two crystalline modifications of methylene iodide are already known to exist [3] Polymorphism is not considered as evidence of chemical difference, but merely of difference in crystal lattice, but one may be permitted to ask, why should alternative lattices be possible, if the molecules themselves are identical in size, configuration, and fields of force? The obvious method of attack here is to investigate the melts obtained from each form, after the manner in which the keto enol transformation has been investigated, and this I shall proceed to do In my opinion, two modifications of methylene bromide and of methylene chloride would also have been observed, had not these bodies been liquid at and below room temperature

A N CAMPBELL

Department of Chemistry,
University of Manitoba,
Winnipeg, Canada

[1] NATURE, Nov 23, 1929
[2] Campbell and Garrow, *Trans Faraday Soc*, **26**, 560, 1930
[3] Beckmann *Zeit physik Chem*, **46**, 853, Bruni and Callegari, *Atti Accad Lincei*, (5) 13, i, 485 (this from Beilstein)

Relation of the Liquid to the Crystalline State

IN a recent note E Gross has found that the Debye elastic heat waves also give rise to modified scattering in liquids [1] The fact that electromagnetic waves are modified by the elastic heat waves shows that the origin of the latter in liquids is also electrical and akin to lattice oscillations in crystals In order to explain facts connected with X ray diffraction in liquids, it

was found that a liquid has to be regarded as a broken up crystal in which there is thermodynamic equilibrium between heat motion and forces of crystal formation.[2] It was seen both theoretically and from observations on X-ray diffraction that there is a maximum in the molecular arrangements in liquids corresponding to the structure of the substance in the crystal state. It is evident that this partial crystallinity of liquids is responsible for the modified scattering found by Gross. It is, therefore, expected that those liquids which produce sharp diffraction effects should also produce sharp modified lines, and it will be interesting to see whether that comes out true.

In the same paper Gross suggests an instructive explanation of the broadening of Raman lines that each Raman line consists of a number of unresolved lines modified further by the elastic heat waves; he supports this view also in his later paper.[3] This does not appear to me sufficient to explain the fact that in some cases where he observed modified scattering due to elastic waves there is no broadening of the Raman lines. The following explanation appears probable to me. In a crystal the natural frequencies of a molecule that are responsible for the Raman effect are modified, due to the surrounding molecules; but on account of the regular arrangement all the molecules are affected in the same manner, and hence Raman lines are sharp. But in a liquid the regularity of arrangement is broken, and hence the broadening out of the natural frequencies of the molecules. We may, therefore, say generally that the more diffuse the X-ray diffraction of a liquid the broader are its Raman lines, provided the natural frequencies of molecules are sufficiently influenced by the surrounding molecules.

KEDARESWAR BANERJEE

Alipore Observatory,
Calcutta, Nov. 15.

[1] NATURE, Aug. 9, 1930, p. 201.
[2] *Ind. Jour. Phys.*, vol. 4, pt. 7, pp. 541-556.
[3] NATURE, Oct. 18, 1930, p. 603.

The Photo-Reaction of Hydrogen and Iodine Monochloride

WE are unable to accept the conclusions of Rollefson and Lindquist[1] that hydrogen and iodine monochloride do not react at ordinary temperatures under the influence of light. These authors maintain that the reaction $H_2 + Cl = HCl + H$ does not readily take place because the Cl atoms resulting from the photo-dissociation of ICl are mostly in the unexcited state. They consider that the accompanying reaction $ICl + Cl = I + Cl_2$ is more probable. We had already concluded certain experiments with H_2 and ICl before the above paper appeared, and had found, as we now find on repeating the work, that H_2 and ICl reacted rapidly in strong light if the hydrogen pressure were large compared with the pressure of ICl. This must mean that conditions favour the greater probability of the reaction $H_2 + Cl = HCl + H$, and that excited Cl atoms may not be necessary for it to take place. The idea, however, that ICl dissociates into normal atoms is not accepted now by the original investigators.[2]

In some of our preliminary experiments we passed carefully purified hydrogen at atmospheric pressure and ICl at a pressure of about 20 mm. into thin glass bulbs, which were then sealed off. The reaction was very slow in artificial light (electric globe), more rapid in diffuse daylight, and very rapid in direct sunlight, I_2 and HCl being the main products. We have also used hydrogen filtered through palladium and dried over phosphoric oxide, and Kahlbaum's purest, crystalline ICl. No special precautions were taken to eliminate possible inhibitors except oxygen. It is easy to understand why the reaction proceeds very slowly compared with the hydrogen chlorine reaction, as the chain will terminate with the formation of iodine atoms.

We hope to publish some quantitative results very shortly.

D. P. MELLOR.
T. IREDALE.

University of Sydney,
N.S.W., Australia.

[1] *Jour. Amer. Chem. Soc.*, **52**, 2793; 1930.
[2] Gibson, NATURE, **123**, 347; 1929. *Zeit. für Physik*, **50**, 692; 1928.

Crystal Structure of Molybdenum Trioxide

CRYSTALS of molybdenum trioxide, prepared by subliming MoO_3 powder, obtained from the pure ammonium compound, have been examined with X-rays. The crystals were small, thin, lustrous plates, parallel to b (010).

Laue photographs showed orthorhombic symmetry. Oscillation photographs about the three principal axes gave the cell size as

$$a = 3.93 \pm 0.02 \text{ A}$$
$$b = 13.91 \pm 0.05 \text{ A}$$
$$c = 3.57 \pm 0.02 \text{ A}$$

These seem to bear no relation to the crystallographic axial ratio given by Nordenskiold,

$$a : b : c = 0.3874 : 1 : 0.4747.$$

There are four molecules of MoO_3 per cell. The space group is Q_h^{16}, (bnm), since $(h0l)$ is halved if $h + l$ is odd, and $(0kl)$ is halved if k is odd. The co-ordinates of the molybdenum atoms are as follows, the centre of symmetry being taken as origin:

$$uv\tfrac{1}{4};\ \bar{u}+\tfrac{1}{2},\ v+\tfrac{1}{2},\ \tfrac{1}{4};\ u+\tfrac{1}{2},\ \bar{v}+\tfrac{1}{2},\ \tfrac{3}{4};\ \bar{u}\bar{v}\tfrac{3}{4}.$$

$u = 36°$, $v = 30°$ approximately.

Intensity measurements are being made on an ionisation spectrometer to fix the oxygen positions.

A full account of the structure will appear later in the *Zeitschrift für Kristallographie*.

NORA WOOSTER.

The Mineralogical Laboratory,
The Museums, Cambridge,
Dec. 8.

The Emission Bands of Sulphur

H. H. VAN IDDEKINGE[1] has made the interesting observation that in the emission spectrum of sulphur produced by him such of the bands as were found by Rosen[2] and Henri and Teves[3] to be diffuse in the absorption spectrum, are entirely absent. This gives strong evidence in favour of the view of 'pre-dissociation' in the molecule.

A few months ago, when I was working at King's College, London, I obtained spectrograms of the emission bands of sulphur by exciting them in a discharge tube containing sulphur vapour in the presence of high pressure argon. Analysis of the bands is in progress, but I find on my plates all the bands recorded in absorption by previous workers and many more towards the red end, and the bands are all sharp. This indicates that argon helps in some way to arrest the pre-dissociation of the sulphur molecule. Analogous influences of rare gases are known, for example, in the production of the Cameron bands, the Baldet-Johnson bands, etc.

In addition to the already known bands attributed to sulphur in the visible and the ultra-violet, a few new bands degraded towards the shorter wave-length side have been also photographed in the extreme ultra-violet beginning from about $\lambda 2100$,

This system apparently extends into the region of the vacuum spectrograph, but until now I have not been able to make any attempt to photograph them there

R K ASUNDI

Wilson College, Bombay, 7,
Nov 14

[1] NATURE, 125, 858, 1930
[2] Zeit für Phys, 48, 69, 1927 48, 545, 1928
[3] C.R, 179, 1156, 1924, etc

An Unusual Sex-Ratio in Red Deer

IT is the practice among stalkers in the deer forests of Scotland to shoot a certain proportion of the hinds each year after the stag shooting season has finished So far as possible the hinds chosen are those called 'yeld' or dry hinds A 'yeld' or dry hind is one which did not have a calf during the preceding season It may either never have had a calf or may have missed a season Consequently the 'yeld' hinds have no calf following them They are almost always pregnant at the time they are shot

In September 1927, whilst staying at Langwell, Caithness, I was informed by H G the Duke of Portland, K G, of a very wide-held belief amongst deer stalkers that these 'yeld' hinds always had a male embryo in the uterus and never a female The Duke, being interested in this matter, sent me six pregnant uteri from 'yeld' hinds shot at the end of 1927 On opening them it was found that five of the embryos were male and one female * In 1928 I received 17 uteri Apparently the hinds had been shot much earlier in the season, for in none of these cases was it possible to determine the sex by ordinary visual examination The genital glands from the base of the kidney were accordingly sectioned, and it was taken that the presence of testicular tissue was positive evidence that the embryo was a male Of the 17 uteri, *one* proved not to contain an embryo at all, and in 3 other cases identification was impossible The remaining 13 embryos were all male

It will be seen that of the cases examined, in which it was possible to sex the embryos, 18 were males and only one female

I feel bound to mention that on arrival at Langwell in 1928 I was informed by the stalkers that one of the 1927 uteri had been sent by mistake, and that it was in all probability not taken from a 'yeld' hind, but even without relating this to the single female in the 1927 cases, the figures appear sufficiently striking

I am deeply grateful to the Duke of Portland, not only for his original suggestion, and for sending the specimens, but also for the kindly interest he has taken throughout

I am also greatly indebted to Dr H S Davidson and Dr J S Sturrock, of the Obstetrical Department of the University of Edinburgh, who prepared the sections of the sex glands, and to Prof Arthur Robinson, of the Anatomy Department of the University of Edinburgh, who finally identified the preparations

GLYN DAVIES

The Jessop Hospital for Women,
Gell Street, Sheffield,
Dec 24

* The Duke incorporated these results in a letter on this subject published in the *Field*

Behaviour of a New Species, *Digitalis mertonensis*

HYBRIDS have often been obtained between *Digitalis purpurea* and *D ambigua*, but it was not until 1926 that a few F_2 seedlings were raised by crossing such hybrids *inter se* [1]

These seedlings were giant, highly fertile, and showed no segregation of the parental characters They had 112 chromosomes and arose by a suppression of the reduction division in their parents, each of which had 56 chromosomes. The inference was drawn that, as in other cases, it was the doubling of the chromosome number that *determined* the regular pairing of identical chromosomes, the formation of uniform germ cells, and consequently fertility

The new form has been carried on for five generations and remains giant and tetraploid The linear measurements of the flowers are $\sqrt[4]{2}$ times those of the diploid hybrid It throws about a quarter of less fertile forms at each generation These are presumed to arise through the occasional pairing and segregation of the homologous chromosomes derived from the opposite parents, as in *Primula kewensis* [2]

It crosses with the parental species, readily with *D purpurea*, less readily with *D ambigua*, but yields offspring which, being triploid, are highly sterile There is no difficulty, therefore, in preserving the new form effectively uncontaminated by crossing, and we consider that it can conveniently be regarded as a new species *Digitalis mertonensis*

Amongst the rare seedlings of *D mertonensis* × *D ambigua* was one small sterile plant showing all the characteristics of the F_1 hybrid and none of the characteristics of the back-cross This plant proved to be diploid At meiosis its chromosomes failed to pair, as in the original hybrid It can only have arisen from an unfertilised germ-cell of its female parent, that is, by parthenogenesis Thus the halving of the chromosome number is associated with the removal of all the conditions associated with the doubling

Since we see that (1) the halving of the chromosome number is directly determined by omission of fertilisation (an intercellular phenomenon), while the doubling of the chromosome number is directly determined by the omission of reduction (an unrelated, intracellular phenomenon), and (2) in both cases the difference between high and low chromosome number is associated with the difference between fertility and sterility, it follows that the change of chromosome number is the cause of the change of fertility rather than a parallel effect of a common cause

B H BUXTON
C D DARLINGTON

John Innes Horticultural Institution,
Merton Park, London, S W 19,
Dec 16

[1] Buxton and Newton, *J Genet.*, 19
[2] Newton and Pellew, *J Genet*, 20

The Designation of Women Biologists

I WAS very glad to see from Prof Cockerell's letter in NATURE of Dec 20, that scientific men now realise the importance of continuity in a woman's name When I first married in 1911 and kept my own name I had to overcome the opposition of a number of the leading scientific people of that day, who bitterly objected to my utilising the laws of our country, which permit a woman *not only to use* her maiden name throughout her married life, but also retain it *as her only legal name* The Royal Society even refused to continue a grant which I had from it unless I adopted my husband's name! So may I, as one who persistently kept her own name for scientific work (and has borne the brunt of the difficulty of doing so against an unreasoning antagonism), welcome and support Prof Cockerell's suggestion that all women should do so?

MARIE C. STOPES.

Heatherbank, Hindhead,
Surrey, Dec 30.

Vitamin B

Assay and Vitamin B_1

THE separation of vitamin B into two factors, antineuritic and antipellagrous, a few years ago, led to considerable attention being devoted to the properties of this vitamin, with the result that it is now possible to distinguish at least four B factors, quite apart from any grouped under the name 'Bios', which may be necessary for the growth of lower organisms The factors are distinguished by differences in their chemical properties and physiological effects their differentiation has necessitated a revision of the methods of assay, since it is possible that a failure to respond to an addition to the diet is an indication of the absence of a factor other than that for which the test was designed In this type of research a preventive test is less delicate than a curative, whilst the growth test may be considered still cruder a single factor should cure the specific symptoms due to its absence, preventive tests may test for more than one, whilst it is clear that a positive growth response can only be obtained when every factor is adequately supplied, and our knowledge of all the factors required for growth is still incomplete, as the recent work on vitamin B has shown

H W Kinnersley, R A Peters, and V Reader (*Biochem Jour*, vol 22, p 276, 1928) have analysed the pigeon curative test for vitamin B_1, or the antineuritic factor By adherence to certain principles, the test can be made reasonably accurate and has been successfully used in following the vitamin in its concentration from a yeast extract The birds should be in the laboratory for a month on a mixed grain diet before being placed on the diet of polished rice, and only those developing symptoms within 30 days should be used As soon as signs of head retraction appear, the bird should be transferred to a warm room for 2 hours and given 50 mgm glucose in water by stomach tube this procedure eliminates birds showing false cures The dose of extract must be given within 6-12 hours of the onset of symptoms and, provided the cure lasts more than 1 and less than 10 days, the amount of active principle present can be considered as directly proportional to the length of the cure After the test is over, the bird is given marmite and kept warm for a few days It is then placed on the stock diet again for about a month, when it is ready for another period of polished rice feeding Individual birds show a remarkable constancy in the time symptoms appear after commencement of the experimental diet, but there is no correlation between this interval and the duration of the subsequent cure, or between it and the colour or weight of the bird

H Chick and M H Roscoe (*ibid*, vol 23, p 498, 1929) have used the growth of young rats as a criterion for the presence of vitamin B_1 It is difficult to carry out a curative test with this animal, since there is only a very short interval between the onset of acute symptoms and death Reader has, however, been successful and has found that the adult rat requires about one pigeon day dose each day (quoted by Peters, the Harben Lectures, 1929) Chick and Roscoe used synthetic diets free from vitamin B_1 vitamin B_2 was supplied as autoclaved yeast or as fresh egg-white After 2 3 weeks the animals began to lose weight growth was resumed if Peters' antineuritic concentrate was then administered The egg-white diet, however, did not maintain growth to maturity B C Guha and J C Drummond (*ibid*, vol 23, p 880, 1929) have used both the pigeon curative and the rat growth tests in the latter, vitamin B_2 was supplied as marmite autoclaved at an alkaline reaction

Chick and Roscoe (*ibid*, vol 22, p 790, 1928) have used a similar method for the assay of vitamin B_2, young rats being placed on a diet complete except for this vitamin, and the B_1 factor being supplied as Peters' concentrate It was found that the caseinogen used contained traces of vitamin B_2 unless it was reprecipitated with acetic acid and thoroughly extracted with alcohol before being heated at 120° Animals on this diet fail to grow but respond to a supplement containing vitamin B_2 If the supplement is not given, after about six weeks a generalised dermatitis appears, which can be cured by administration of the vitamin

B C P Jansen and W F Donath (*Mededeelingen van den Dienst der Volksgezondheid in Ned Indië*, Anno 1927, Part 1) obtained highly active preparations of vitamin B_1 from rice polishings by a process involving extraction with acid water, adsorption on fuller's earth, elution with baryta, and fractionation of the extract with silver sulphate and baryta The activity was precipitated with phosphotungstic acid, the precipitate decomposed with baryta, and after removal of barium the concentrated solution was treated with platinic chloride, which precipitated the vitamin Further purification was effected by acetone precipitation from alcoholic solution and by treatment with picrolonic acid or gold chloride 0·012 mgm of the final fraction a day was sufficient to maintain pigeons in health over six weeks C Eykman (*Kon Akad van Wetensch Amsterdam*, vol 30, p 376, 1927) confirmed the activity with both pigeons and cocks The final product was obtained in crystalline form, as a hydrochloride, a picrolonate, or a double salt with gold chloride

Kinnersley and Peters (*Biochem Jour*, vol 22, p 419, 1928) have continued their work on antineuritic yeast concentrates (see NATURE, vol 121, p 516, 1928) It is not yet certain whether the curative substance is the same as that obtained from rice polishings by Jansen and Donath the activity of the final product does not appear to be quite so great and its properties are not quite the same In all work on the concentration of vitamin B_1, it has been found that the properties of the active fractions vary according to the nature of the accompanying impurities, so that methods developed for use with an extract of rice polishings may not be applicable without modification to an extract of yeast The extract from the charcoal adsorption, after removal of metals, can be fractionated by successive additions of alcohol, the

vitamin passing into the portion soluble in 99 per cent ethyl alcohol The authors failed to get consistently successful results with a silver fractionation, but were more successful with the use of phosphotungstic acid and platinic chloride The most active preparations contained a day dose in 0 027 mgm , but more lately some have been obtained with a curative activity of 0 01 mgm a day dose

Guha and Drummond (*loc cit*) prepared active concentrates from wheat embryo After extraction by means of acid alcohol, two different methods of concentration were employed in the first, impurities were precipitated by lead acetate, and the activity adsorbed on norite charcoal at pH 4 5 and eleuted with acid alcohol it was then precipitated by phosphotungstic acid, adsorbed on silver oxide, and the product fractionated with alcohol Picrolonic acid then precipitated impurities from the material, which was soluble in alcohol The first product had a pigeon day dose of 0 043 mgm In the second method, Jansen and Donath's process was followed, namely, adsorption on fuller's earth at pH 4 5 and eleution with baryta, and fractionation with silver nitrate and baryta followed by precipitation with phosphotungstic acid The product was then submitted to precipitation with platinic chloride, followed by gold chloride, at the last stage most of the activity passed into the precipitate, but it was observed that smaller doses of both precipitate and filtrate together restored growth in the rat or cured the pigeon than of either when given separately, suggesting that vitamin B_1 may itself be composed of more than one factor The smallest pigeon day dose was 0 0025 mgm , and 0 015 mgm promoted good growth in rats These figures indicate that the preparations were more active than the crystals obtained by Jansen and Donath

Although formulæ have been assigned to vitamin B_1 preparations, it does not appear that a pure substance has yet been isolated A certain amount is, however, known about its properties It appears to be a tertiary base it is soluble in water and alcohol, but is unstable in the latter solvent when highly purified it is insoluble in the other common organic solvents It is destroyed by alkali, but is stable to oxidising and reducing reagents and to nitrous acid Cruder preparations give a definite Pauly reaction, but as purification proceeds the reaction becomes very weak Sulphur is absent and the purer preparations do not give the xanthoproteic, purine, or Millon's reactions In extracts from rice polishings, after treatment with lead acetate and concentration of the filtrate, vitamin B_1 is destroyed by fermentation and by heating to 95°, and is removed by filtration through a Berkefeld filter (J L Rosedale and C J Oliveiro, *Biochem Jour* vol 22, p 1362 , 1928), although it will dialyse through cellophane

The isolation from contentrates of supposedly pure substances and the fact that false positives may be given by the pigeon test have led to claims that different pure compounds are the vitamin J M Gulland and Peters (*ibid* , vol 23, p 1122 , 1929) have examined the claims that certain quinoline and glyoxaline derivatives have curative properties Without exception all those examined, including 4 (or 5) glyoxaline methylethyl carbinol hydrochloride and 2 6-dihydroxyquinoline, were quite inactive when tested on pigeons by Peters' technique

The Adler Planetarium of Chicago

THE Adler Planetarium is a new and striking feature on the shore between a small lagoon and Lake Michigan In plan it is dodecagonal the walls are faced with large slabs of red granite and it is surmounted by a dome The principal object of this new institution is explained on the dedication plaque that confronts the visitor when he crosses the threshold of the entrance lobby Eight sculptured figures by Vannelli, symbolising the eight principal planets, are disposed around a circular disc representing the sun, upon which is set the inscription "*The Astronomical Museum and Planetarium of Chicago—Gift of Max Adler—To further the Progress of Science—To guide to an Understanding of the Majesty of the Heavens—To emphasise that under the Great Celestial Firmament there is Order, Interdependence and Unity—1930* "

For this purpose the principal instrument is a large projection apparatus built by the firm of Zeiss on lines similar to those of the one described in NATURE for Dec 27, 1924, p 937, and by which large audiences can watch the movements of the starry firmament as projected upon the inside of the great dome of 68 feet in diameter On the north and south sides of the dome are two spacious exhibition halls, while to the east of it are library, lecture- and work rooms, and also the office of the director, Dr Philip Fox

The Adler Planetarium is, however, designed on broader lines than those of a public hall for planetary demonstrations It includes a collection of important historical instruments used by astronomers in past centuries Among the more modern instruments are one of Sir William Herschel's reflecting telescopes, given by Sir Frank Dyson with the authorisation of the British Admiralty , Burnham's 6 inch telescope, loaned by the University of Wisconsin, with various mementoes of him , Nichol's star heat radiometer from the Yerkes Observatory , refractors loaned by Carl Zeiss and by Richard E Schmidt , a large model of an observatory with movable dome, telescope, and floor, based on the U S Naval Observatory An appropriate exhibit is an orrery by Isenbroeck, of 1737 , while in wall-cases are displayed that important series of instruments of earlier date, known as the Mensing Collection, which was purchased *en bloc* in January last by Mr Adler from the firm of Messrs Frederik Muller and Co , of Amsterdam

While keenly regretting the loss to Europe of so many astrolabes, armillary spheres, sundials

early telescopes, sextants, and surveying instruments—all most interesting relics of the past—it is well that the great country of America, where science is relatively so new, should have some material record of the tools by which astronomical knowledge has been painfully won, and taught, in the Old World. Thanks to the generosity of yet another recruit to the ranks of noble benefactors who have given the United States its greatest institutions, Chicago now takes the lead among American cities equipped for the study of the instruments of ancient astronomers. Thanks to Dr. Adler, within a few months the city has acquired historical riches surpassed only by the famous collections of European cities, such as Munich, Dresden, Paris, London, and the Lewis Evans Collection at Oxford. The selection has been ably made and arranged by Mr. Adler's lieutenant, Dr. Fox, and the instruments will be on view at the Chicago Centenary Exhibition this year, with the planetarium as the most considerable side show. We require benefactors like Mr. Adler in Great Britain.

Obituary

SIR OTTO BEIT, K.C.M.G., F.R.S.

DURING the last fifty years, and more especially in the last twenty-five, much has been done in Great Britain to promote the advancement of the science of medicine, by providing facilities for the furtherance of research, both by the development of laboratories of high efficiency and also by the foundation of research fellowships to enable investigators of promise to pursue their work. Many generous benefactors have taken a part in this work; some have built institutions or laboratories, others have endowed professorships, and others have founded research fellowships.

Amongst those who have devoted their benefactions to the foundation of fellowships, the name of Sir Otto Beit will always be honoured, not merely, or even mainly, for the magnitude of his foundation, which amounted to nearly a quarter of a million sterling, but rather for the breadth of view that determined the scope of the scheme that was founded as a memorial by him to his brother, the late Mr. Alfred Beit. Mr. Alfred Beit had taken a considerable interest in certain proposals that had been made in the early years of the present century for improving the teaching of the earlier subjects of the medical curriculum of the University of London, and had made a gift of £25,000 towards this object and bequeathed a further like sum for the same purpose. The scheme failed to secure the necessary support of those concerned, and, consequently, the gift and the legacy ultimately lapsed, and reverted to the residuary legatee, Sir Otto Beit. He decided to use the money to establish a memorial to his brother, to whom he was devotedly attached; and after consultation with, and advice from, Sir James Kingston Fowler, the late Prof. Starling, and others, the scheme was promulgated in December 1909 as a "Memorial to his brother, Mr. Alfred Beit, to promote the advancement by research of Medicine, and the Allied Sciences in their relation to Medicine."

Although the scheme was originally drafted on the basis of the provision of a capital sum of £25,000 and the foundation of three fellowships, it transpired that Sir Otto had increased the benefaction tenfold, and one, at any rate, of his advisers only learnt this by telephone from him, twenty-four hours before the announcement was made publicly. This act exemplifies not only the great generosity of the donor, but also the decision with which he acted when he considered the proposals put before him were such as to deserve support.

Although the Foundation is justly remarkable for its magnitude, it is more especially to be commended for its scope. Many benefactors would have desired to impose limitations; some would have failed to realise that medicine can be furthered in any other way than by research directed to some immediate so-called practical object, for example, the eradication of some individual disease. Not so in the case of Sir Otto Beit; and hence the inclusion in the scheme of the "Allied Sciences in their relation to Medicine." He was well aware of the close and intimate connexion of many sciences, not only with the science of medicine, but also with the practice of the art of medicine.

The actual scheme of administration of the Foundation was modelled on that adopted by one of the City companies, namely, the Worshipful Company of Grocers, in its scheme for the award of the well-known Grocer Research Scholarships in Sanitary Science. This City company in the early 'eighties established three scholarships for the promotion of research into the nature and prevention of disease, and always allowed its scientific advisory committee a wide discretion in interpreting the relation of the proposed research to the actual practice of medicine; and many Grocer scholars have made notable additions to knowledge in physiology and in pathology as well as in pure medicine, and thus medicine has been assisted both directly and indirectly. This same policy has characterised the awards of the Beit Fellowships; and the record of the discoveries of the Beit fellows in the course of the last thirty years is one of which any Foundation might be justly proud. Sir Otto Beit, as chairman of the Beit Trustees, took a personal and active interest in the work of the fellows, and was remarkably conversant with their work, as throughout his life he took a lively interest in the progress of medical knowledge.

In November 1928 he made another very notable benefaction to medical science, by giving King Edward's Hospital Fund £50,000 for the purchase of radium for the benefit of London hospitals; and shortly before his death he gave a further £8000, required by King Edward's Hospital Fund to complete the purchase of a further quantity of radium. Here again the value of the gift was greatly increased by the wise foresight of the donor. Many donors would have been satisfied by merely providing radium for the relief of suffering, but Sir Otto Beit went much further by saying that he "should

like the Committee to endeavour to secure that the hospitals thus to be provided on loan with radium, should be preferably those in which the cure of disease, or the alleviation of suffering, is associated with a keen interest in the furtherance of knowledge 'for the relief of man's estate'"

This shows very clearly the wide view and the profound interest he took in the advance of knowledge, and his great faith in the paramount necessity of research Few laymen had such an intelligent appreciation of the problems of medical research, and of the need of much patient work before the realisation of success, and he was not one who was always expecting immediate and striking results to follow on a programme of work

Sir Otto Beit was elected a fellow of the Royal Society in 1924, and certainly it may be said of him, in the words of the statutes of the Society, that he had "rendered conspicuous service to the cause of science" JOHN ROSE BRADFORD

ON the death of Sir Julius Wernher in 1912, Sir Otto Beit took his place as a representative of the Crown on the Governing Body of the Imperial College of Science and Technology, thus preserving unbroken the close connexion of the College with the famous firm of Wernher, Beit and Co Sir Julius Wernher himself was an original member of the Governing Body, and took an influential part in the negotiations which led to the foundation of the College in 1907 Practically the whole of the endowment of the College since its incorporation has been provided by Sir Julius Wernher, Mr Alfred Beit, and Sir Otto Beit

Sir Otto Beit was an active and inspiring member of the Governing Body A firm believer in the intellectual and practical value of the highest scientific education, he did everything in his power to promote it In 1913 he created a Trust Fund, which he increased later to £26,500, to provide for Research Fellowships tenable at the College and open to men and women of European descent by both parents, but otherwise of any nationality, being graduates of universities within the British Empire From time to time he gave sums of money, amounting to £32,500 in all, towards the cost of the Imperial College students' hostel and of the extension to the hostel and the students' union which forms part of a new building now nearing completion His other gifts, which were many in number, included a sum of £10,000 towards the general development of the College in a time of financial stringency

These benefactions are illustrative not only of Sir Otto Beit's generosity, but also of his good judgment He never gave money away indiscriminately, he had a clear insight as to the right thing to do at the right moment He was always ready to be guided, but never allowed himself to be swamped by the enthusiasm of others It was this quality which brought him the full confidence of his colleagues, and when in 1919 Sir Francis Mowatt resigned the chairmanship of the finance committee of the Governing Body shortly before his death, there was no hesitation about the appointment of his successor Sir Otto Beit continued to hold this important post until his death, and though he was greatly handicapped in recent years by ill-health, he worked untiringly to further the interests of the College He interested himself not only in the government of the College, but also in the life of the students, many of whom are indebted to him for unobtrusive acts of kindness We have lost a great friend and a great benefactor

H T TIZARD

PROF C E MOSS

THE death on Nov 11 last of Prof C E Moss, at his home in Johannesburg, at the age of sixty, is a serious loss to South African botany and to systematic botany at large Charles Edward Moss was a native of Cheshire, the youngest child of a Nonconformist minister who settled at Halifax in 1874 He gained his early education at elementary schools in that town, eventually becoming a pupil teacher At the age of twenty-three he had a serious illness and his convalescence involved spending much time in the open air This led to a keen interest in field botany and close acquaintance with the local naturalists, who were at that time a very active body Moss thus became a competent field botanist before he was able, at twenty-five years of age, to go to the Yorkshire College, Leeds, and work for his degree as well as his teacher's certificate At Leeds he found Miall's teaching and outlook very acceptable, and in 1896, when the late Dr W G Smith went to Leeds as lecturer in botany, Moss was greatly attracted by the new method of studying and mapping plant communities in the field which had been inaugurated in Scotland by Smith's elder brother Robert

Moss took his degree in 1898 and collaborated with Smith in the first 'primary survey' of vegetation to be made in England (Leeds and Halifax district), published in the *Geographical Journal* in 1903 He also published several minor botanical studies in local journals After leaving Leeds he taught at a school in Bradford, and later at Bruton in Somerset, where he applied the new method to the local vegetation with conspicuously successful results In the Somerset paper, too, which was also published by the Royal Geographical Society (1907), he worked out a logical system of units of vegetation which he elaborated later in another publication (1910), and which was made the basis of the treatment adopted in "Types of British Vegetation" (1911) Moss was anxious to leave schoolmastering, and in 1902, at some financial sacrifice, he migrated to Manchester and lectured in biology at the Municipal Training College, at the same time improving his knowledge of general botany by attending honours lectures at the University

In 1904 the British Vegetation Committee was founded to facilitate the co-operation of the small band of active workers on the survey of British vegetation Moss was one of the original and certainly one of the most valuable members of the Committee His acute logical mind and his

increasingly critical knowledge of species were of the greatest use in accelerating the rapid advance in our knowledge of British vegetation which marked the first decade of the century While at Manchester he undertook a survey of the Peak district which gained him his D Sc degree and was published much later (in 1913) by the Cambridge University Press In 1907 Moss was invited to go to Cambridge as Curator of the University Herbarium, and gladly accepted the invitation, though again at some financial sacrifice He joined Emmanuel College as an advanced student and took his B A degree by research During the ten years he was at Cambridge he lectured in systematic botany, demonstrated to the elementary students, and was very active in field work

From about 1910 Moss turned more and more to critical systematic botany After publishing several excellent and illuminating critical papers on different small genera, he conceived the idea of a new British flora on a monumental scale This the University Press agreed to publish as the "Cambridge British Flora", and vol 2, dealing with the Amentiferæ and allied families, to which Moss had paid special attention, appeared in 1913 The outbreak of War, however, seriously compromised the financial prospects of this ambitious undertaking, and, together with other difficulties, led to the suspension of the work, only one other volume (vol 3) appearing, under the editorship of an old pupil, Mr A J Wilmott of the British Museum, after Moss had left England

In 1917 Moss was appointed to the professorship of botany at Johannesburg, and here he gradually developed a very living and flourishing department, which was becoming a centre of research on South African floristics At the same time Moss applied himself with characteristic energy and thoroughness to the task of becoming acquainted with the South African flora He found that the published and herbarium material was to a large extent untrustworthy, and he set himself to revise various groups, travelling widely for the purpose for he was never content until he had seen the species he studied in their native habitats He had published very little since he went to South Africa, but he had a large amount of material in hand Another five years would almost certainly have seen the appearance of so great a body of accurate systematic work as would have securely established his repute as a critical taxonomist of high rank

Moss was a man of singularly acute, logical, and independent mind With no adventitious advantages, he fought his way by sheer ability, hard work, and devotion to his subject, to a high place in the science After attaining one reputation as a pioneer ecologist, he was making another, no less distinguished, as a taxonomist, and only his untimely death has prevented its full fruition A G T

PROF FELIX LÖHNIS

BY the death at Leipzig on Dec 8 of Prof Felix Löhnis, the science of bacteriology has sustained a serious loss Löhnis was born in Dresden on Aug 3, 1874 After he left school and before he finally turned his attention to academic work he was engaged in practical agriculture for several years In 1901 he received the degree of Ph D from the University of Leipzig, and in 1905 he became responsible for the instruction and research in agricultural bacteriology in that University During the period 1905–1914 Löhnis's investigations did much to clarify the position of his subject The chief contributions of his department were concerned with methods, the seasonal variation in bacterial activities, the decomposition of calcium cyanamide, and nitrogen fixation This period in Lohnis's career was also notable for the publication of a manual of methods which has been translated into several languages, a text-book which is still the best work of its kind on the subject, and the well-known "Handbuch der landwirtschaftlichen Bakteriologie", which is the only comprehensive and critical review of the literature in existence In 1912 Löhnis had attained a position of such eminence among agricultural bacteriologists that the British Association extended to him an invitation to address Section M (Agriculture) at the Dundee meeting

In the spring of 1914 Löhnis was offered and accepted an appointment in the United States Department of Agriculture, and in 1923 he took over the direction of the Department's work on the bacteriology of soils Between 1914 and 1923 he devoted much of his time to researches on the life-cycles of the bacteria The results of this work, contained in a monograph published in 1921 and in other papers, are of a far reaching nature, challenging as they do the fundamental principle of monomorphism, upon which the science of bacteriology has been built Whether all Lohnis's views will be accorded general acceptance is still uncertain, but there is no doubt that his investigations on the life histories of bacteria will exert a profound influence upon the ultimate development of the science

In 1925 Lohnis returned to the University of Leipzig as professor of agricultural bacteriology and soil science, and in a very short time he had under his direction a volume of work which was probably greater than that undertaken by any other department of the kind in Europe The chief contributions of the later years are those which deal with the fermentative and other changes which take place in the making of the various types of farmyard manure and in the preservation of forage crops In 1929 Löhnis became editor of the *Zentralblatt für Bakteriologie*, Abt II, and a short time before his death he was at work upon a new edition of his "Handbuch"

Those who have had the privilege of working under Löhnis will always treasure the remembrance of his enthusiasm and inspired direction In the planning, conduct, and supervision of research he was unsurpassed, and his intuition frequently proved to be of quite an exceptional nature In such matters his extensive and accurate knowledge of the literature of his subject was of the utmost value It also enabled him to detect at once the rather frequent modern practice of

publishing, as new discoveries, already well established facts Of all such tendencies, as well as of work carried out in a perfunctory manner, he was most intolerant and did not hesitate to express his opinion in emphatic terms His later publications were often greatly condensed and consequently difficult to read As a result he has sometimes been misunderstood and has not always received the credit to which his work entitles him His contributions to science, however, have been outstanding and will yet cause his name to be placed among those of the pioneers in bacteriological work

DR P PINKERTON

PETER PINKERTON was born in Kilmarnock on Jan 8, 1870, and received his early education at the Academy there At the University of Glasgow he gained the degree of M A with highest honours in mathematics, and afterwards he studied for two years at the Royal College of Science, Dublin After a period of six years as mathematical master in Allan Glen's School, Glasgow, he was appointed head of the mathematical department of the Royal Academical Institution, Belfast, a position which he resigned after a short tenure to take up a similar one in George Watson's College, Edinburgh Sixteen years ago he was appointed Rector of the High School of Glasgow, and he discharged the varied and responsible duties of that post with marked success and increasing distinction until his death on Nov 22 last

Dr Pinkerton was a very great teacher He had an exceptionally alert mind and an unfailing sense of humour About a very clever student he once remarked, "He will make a poor, poor teacher, he never had a difficulty" His own outstanding success was largely due to his complete sympathy with all his pupils He appreciated the difficulties of the dull, as well as the eager curiosity of the brilliant

Under Dr Pinkerton's inspiration and guidance, marked developments took place in the High School of Glasgow The intellectual and social life was quickened, and the provision of splendid playing fields opened up a new era in athletics Quietly and unobtrusively he devoted all his powers of mind and heart to the welfare of the School in all its aspects, and its betterment was his constant aim

Dr Pinkerton was a prominent member of the Edinburgh Mathematical Society, and served as secretary, as president, and as first editor of *Mathematical Notes* He frequently contributed to the *Proceedings*, and was the author, in collaboration with the late Prof Gibson, of a book on the "Elements of Analytical Geometry" Throughout this volume old students have no difficulty in recognising his characteristic methods of treatment and exposition

The University of Glasgow, for which Dr Pinkerton acted as examiner for degrees in mathematics at various times, conferred on him the degree of D Sc in 1909 and of LL D a few months before his death

DR H BORNS

THE death of Dr Henry Borns on Dec 12 last, at the age of seventy-five years, removes a very familiar figure from the meeting-places of scientific societies in London Until the last year or two, when ill-health made his attendances not so regular, he was present at nearly every meeting concerned with physics or subjects related thereto Always one would find him busily reporting the proceedings (for many years he acted as reporter for *Engineering*) and anxious to supplement his notes by a talk with the lecturer and a perusal of the manuscript Although he was thus well known to the secretaries of the societies, few people seem to have known him intimately He seldom volunteered information about himself, and he probably led a rather lonely life apart from his meetings He was born in Austria, but must have come early in life to England, for he became a member of the British Association forty-eight years ago, attended the Montreal meeting in 1884, and missed very few meetings since that date He joined the Physical Society in 1895, and was an original member of the Faraday Society

Dr Borns in the course of his work acquired a wide knowledge of physical subjects and his reports displayed expert discrimination His notes were made without ordinary shorthand, in a curious abbreviated script, presumably legible to himself but a terror to his correspondents, for he used it in his letters also He was a kindly soul, always anxious to be of assistance to the secretaries with whom he came into contact, and punctual in keeping his promises for the return of manuscripts lent to him For half a century in a quiet way he served science well and faithfully, by giving it the best form of publicity—that based on accurate and well informed records His many scientific friends will miss him greatly

WE regret to announce the following deaths

Mr J H Emerton, an authority on American spiders and formerly secretary of the New England Federation of Natural History Societies, on Dec 5, aged eighty three years

M Henri Gall, a former president of the French Society of Civil Engineers and president of the Industrial Chemistry Society, aged sixty eight years

Prof Emile Gley, professor of general biology in the Collège de France, who was known for his work on the ductless glands, particularly the thyroid and parathyroid, aged seventy three years

Dr O P Hay, formerly of the Carnegie Institution of Washington, known for his researches in Pleistocene palæontology and as author of the "Catalog and Bibliography of the Fossil Vertebrates of North America", on Nov 2, aged eighty four years

Prof E W Hyde, formerly professor of mathematics at the University of Cincinnati and vice-president in 1891 of Section A of the American Association for the Advancement of Science, aged eighty seven years

Vice Admiral Sir Charles Royds, K B E, who served as first lieutenant of the *Discovery* in the British Antarctic Expedition of 1901–4, on Jan 5, aged fifty four years

News and Views

THE important announcement has just been made that in the near future there will be established in the vicinity of Toronto an astronomical observatory which will rank with the world's greatest institutions of this kind It will be erected by Mrs D A Dunlap and her son, D Moffat Dunlap, as a memorial to the late David A Dunlap, who died on Oct 29, 1924, and will be known as the David Dunlap Observatory Astronomy and geology were both favourite studies of Mr Dunlap, but the former had a peculiar attraction for him He was a keen student of the heavens, and always liked to share his knowledge with others This project has been under consideration for the last five years and will now be brought to completion In working out the plans, Mrs Dunlap has had the assistance of Prof C A Chant, head of the Department of Astronomy of the University of Toronto

THE outstanding feature of the David Dunlap Observatory will be a large reflecting telescope seventy four inches in diameter There is only one of greater aperture in the world, namely, that on Mount Wilson in California The instrument was ordered some time ago from the firm of Sir Howard Grubb, Parsons and Co, of Newcastle on Tyne It will be housed in a circular metal building, such construction being best for this purpose The observatory building will be a beautiful structure in the classic style It will be erected on a suitable site near Toronto, in the midst of a large acreage which will be converted into a park, to be known as the David Dunlap Park When the observatory is completed, it will be under the Department of Astronomy of the University of Toronto, while the park will be developed in a scientific way by the Faculty of Forestry The new institution will bring distinction to the University the city, the province, and indeed the whole Dominion It will be an enduring memorial to a worthy citizen

IN a recent leading article (see NATURE, Nov 22, 1930, p 797) we pointed out the urgent need for increased attention to the systematic study of the Indian peoples and cultures in view of the probable political conditions of the future Bearing on this, it may be mentioned that Lord Winterton, in the *Empire Review* for January, closes an article discussing the problems of form and organisation in the government of India, with which the Round Table Conference has been concerned, by very pertinent illustration of the extraordinary range of variation in the peoples whose destiny is being decided Discussion since the Conference opened has served to bring out even more clearly the fundamental importance, beneath the purely political problem, of questions of race, of religion, and of culture At the same time, letters to the Press, such as that from Mr Codrington which appeared in NATURE of Dec 13, 1930, p 919, and the correspondence in the *Observer* and elsewhere, while directing attention to such facilities as exist in England for Indian studies which are essential to the understanding of these questions, have emphasised their inadequacy

STRONG support for the views on the question of anthropological studies in India itself, which we ourselves expressed, may be drawn from the presidential address delivered in the Anthropological Section at the seventeenth Indian Science Congress held last year at Allahabad and now available in the recently published congressional proceedings (Calcutta Asiatic Society of Bengal, 1930 15 rupees) The president, the Rev P O Bodding, most urgently impressed upon his hearers the necessity for a record of the facts relating to custom, even the commonest facts of everyday life Admitting the attraction of theory, he pointed out that an unbiased and uncoloured record of the facts is an essential preliminary to study, and alone affords any certainty of permanent value Mr Bodding is primarily and indeed solely interested in the scientific aspect of the matter but he made use of a cogent argument in support of his plea, the force of which is equally, if not more, applicable in relation to the bearing of anthropological study upon the problems of administration In India to day, he urged, change in custom is taking place continuously and everywhere He quoted from his own long experience among the Santals, where, for example, their attitude of mind in marriage customs appears to have changed entirely, passing, it would seem, from an attitude of potential hostility to one of union with the 'parties of the other part', while in religion, it is now customary to find that at the celebration of a Hindu festival the greater number of the participants, and those who make the most noise, are Santals, officially classified as 'animists' It is obvious that if from the scientific point of view it is important that a record of the facts should be preserved at the earliest possible as well as at the later stages of development, it is no less important that the administrator should have an exact knowledge of the changes that are taking place and of their direction

A CURIOUS feature of the industrial situation is the pronounced shortage of administrators competent to direct and organise industry on the scale which the magnitude of modern industrial combines and their international relationships require Men of the requisite ability are not automatically produced by the present system On the contrary, authorities such as M Henri Fayol have pointed out that under the specialisation involved in rationalisation the departmental manager or executive rarely has the opportunity of gaining the wider experience which is essential in higher administrative duties It has been authoritatively estimated, moreover, that in the case of the managing director even of a highly technical organisation, the amount of technical ability essential is only 10 per cent as compared with 50 per cent of administrative ability, and even in the head of a technical department 35 per cent of administrative as compared with 30 per cent of technical ability is required Such factors accordingly present serious obstacles in the promotion or training of staff for promotion to the higher administrative positions Valuable work to remedy this state of affairs is being

done in Europe by the International Management Institute founded in 1927 by the XXth Century Fund, the International Labour Office, and the International Committee for Scientific Management This Institute has already made a number of important studies on the application of scientific management in special factories, in banking, and in railway undertakings, and is fast becoming a clearing house of world information and a focus of activity on all questions covered by the resolutions of the World Economic Conference

IN Great Britain the Institute of Industrial Administration is carrying out similar work, and claims to have united in a comprehensive view the principles underlying the various aspects of industrial administration It aims, further, at establishing industrial administration among the recognised professions, and with the further objects of education and the maintenance of high standards of skill and responsibility among its members, has modelled itself to some extent on the lines of established professional institutions In opening a public discussion on Dec 12, Mr A S Comyns Carr, president of the Institute, pointed out that modern competition calls for a higher standard of administration, to eliminate waste and reduce costs of production, as well as in the introduction of new methods, and this is true of all sizes of business undertakings and of marketing as well as of production Mr Comyns Carr believes that the foundations of the knowledge required can be laid by suitable reading and instruction, and that examination can test these foundations and the capacity for initiative and common sense Primarily, in its educational work, the Institute is an examining and not a teaching body Arrangements are now being made by educational authorities to provide instruction by lectures in some or all of the subjects of the Diploma of the Institute, and this work is supplemented by the formation of a Students' Society to provide reading courses at very moderate fees

ONE of the present Government's measures for assisting agriculture has been the Land Drainage Act of 1930. It would appear to be a popular subject with politicians and recent governments, when asked what they have done for agriculture, have generally been able to give good accounts of what they have done to encourage the drainage of agricultural land The cynic asks why this zeal for draining, when the land that is already drained cannot produce crops at a profit There has, however, been a definite need for the present Act, and Mr A T A Dobson has explained this and the provisions of the Act very clearly and concisely in a paper read recently at the Surveyors' Institution Rationalisation is a universally acclaimed palliative for our economic troubles to day Agriculture cannot expect to escape, nor does it deserve to This Act rationalises one thing in agriculture, the law of land drainage it is intended to produce order out of something approaching chaos Previously there was a large number of drainage districts under the jurisdiction of authorities of different types, and there was too much clashing of responsibilities and interests Large rivers were rarely dealt with satisfactorily The War years caused drainage works to fall badly into arrears In 1926 trouble arose in the Great Ouse district in the form of passive resistance to the payment of drainage rates A special Commission was set up in consequence, followed by a Royal Commission to investigate the whole question of the law of land drainage

THE present Land Drainage Act follows closely the recommendations of the Royal Commission, and most of Mr Dobson's paper is devoted to an explanation of its provisions The general effect is that there will be two classes of drainage authority the catchment board, responsible for all works on its main river, with supervisory jurisdiction over a wide area, and with considerable powers of raising revenue, and the ordinary drainage board, called within a catchment area an internal drainage board, responsible for the drainage of limited areas Mr Dobson then describes the methods of financing the drainage operations of these two types of authority, explains other points in the Act, and concludes by claiming that "the Act provides the necessary machinery for securing that, in future, all the waterways and drainage channels in England and Wales can be kept in a proper state of efficiency, including main rivers" If this proves to be the case, a very useful and necessary Act has been passed

REPRESENTATIVE exhibitions of British chemical plant are of infrequent occurrence Though the last one, held in 1926 in conjunction with the London meeting of the Society of Chemical Industry, was very successful, a favourable opportunity for repeating this venture has so far not occurred A unique opportunity for remedying this state of affairs and for bringing British chemical plant to the notice of the chemical and allied industries throughout the world will occur next July on the occasion of the jubilee celebrations of the Society of Chemical Industry The British Chemical Plant Manufacturers' Association has decided, in co operation with the Chemical Engineering Group of the Society, to stage an exhibition which will be open during the whole week of the celebrations, July 13–18 inclusive, at the Central Hall, Westminster The exhibiting area will be twice as great as in 1926 The exhibition will cover all types of plant, apparatus, instruments, constructional materials, and general equipment required by the chemical industry and the numerous other branches of industrial activity associated with it Only makers of British plant will be eligible to exhibit There will be a section devoted to the work of the various research associations and to the Department of Scientific and Industrial Research, this will be organised on non trade lines by the Chemical Engineering Group of the Society of Chemical Industry, and its object will be to demonstrate the important part which science plays in the development of British industry and in the control of the products Admission to the exhibition will be free, and invitations will be widely distributed to those who are interested in British chemical plant The public will also be admitted free on the Friday

afternoon and the Saturday Special steps will be taken to ensure the production of a fully classified catalogue, which will be supplied free either on admission or on application to the British Chemical Plant Manufacturers' Association Further information regarding the exhibition can be obtained from the office of the British Chemical Plant Manufacturers' Association, 166 Piccadilly, London, W 1

THE Newcastle upon Tyne Electric Supply Co and its associated companies supply an area exceeding 4000 square miles, extending from Scarborough to Alnwick and including York The power supplied is used for domestic purposes, mining shipbuilding engineering, and general manufacturing The system of supply is three phase alternating, at voltages ranging up to 20,000 Naturally the accurate metering of all this energy was a problem of great difficulty A full description of the difficulties and the methods by which they have been overcome is given in a paper read to the Institution of Electrical Engineers on Jan 2 by E Fawssett and G E Moore The records show that good meters need not be examined oftener than once a year Small meters are only examined once in every two years and very small meters once in every four years The meter readers use motor cars which carry the testing equipment including check meters Each car carries two testers each of whom must be able to drive the car and perform all the routine tests About forty cars are always at work, and the performances of the meters under a variety of conditions are tested the larger meters being subjected to more thorough tests It is found that the lower bearing of the meter disc which revolves on a vertical spindle is the most unsatisfactory part of the whole meter Oil is used to prevent rust and the pivot and the jewel are immersed in it Considering that electric meters are running sometimes for years at a stretch with a maximum inaccuracy of sometimes less than one per cent it will be seen to what a pitch of perfection manufacturers have developed them It is satisfactory to learn that the cost of the elaborate arrangements made to safeguard the revenue of the Newcastle company by accurate metering is less than the thousandth part of the revenue

IN 1914 the developments in the design of thermionic relays enabled a telephone cable to be laid across the United States from ocean to ocean Each relay has a filament from which electrons are liberated when it is heated by current from a battery The most desirable filament at present in use is that used in the circuits of the Bell Telephone System It consists of a platinum alloy the surface of which is coated with a mixture of barium oxide and strontium oxide A minute trace of barium in each filament permits the use of a much smaller amount of power for heating We learn from the *Bell Laboratories Record* for October that a quarter of a million telephone repeaters are in everyday use The amount of barium used for each filament is only about one sixth of a microgram For all the tubes in use the total amount of the barium effective in the emission of electrons is not more than the twentieth of a gram A clean tungsten filament required 35 watts for heating as compared with only 2 2 watts required for a filament coated with barium. Multiplying the quarter of a million tubes in use by the cost of the current taken from storage batteries, we see how the minute quantity of barium utilised in accordance with the methods found by fundamental research effects a great saving in the commercial working of the system Experiments are quoted that prove the remarkable fact that the electron current which is possible at any heating temperature from a single layer of barium atoms on a platinum wire is enormously greater than the current which could be obtained from a filament of either substance alone

SINCE 1926 there has been issued at Woods Hole a paper devoted to the work and workers at the Marine Biological Laboratory and the Bureau of Fisheries Laboratory With the increasing number of workers at Woods Hole the need for some such organ is apparent The *Collecting Net* as it is called is issued weekly during the summer months and contains besides items of local interest to workers short summaries of some of the research carried out at the laboratories each accompanied by a critical review A glance at last year s issues together with the directory of investigators emphasises how Woods Hole becomes during the summer months a great meeting ground for biological workers who form a unique community some hundreds strong But this centre of biology is to be even further enriched by the addition of the largest oceanographic institution in the world The issue of the *Collecting Net* for Aug 30 of last year contains plans and details of the proposed Woods Hole Oceanographic Institution the construction of which has already begun The Institution has been endowed by the Rockefeller Foundation with grants of 1 000 000 dollars to finance the buildings and equipment and 1 000 000 dollars as a permanent endowment fund An additional working grant of 50 000 dollars a year has been promised for a period of ten years The Institution is under the directorship of Dr Henry B Bigelow and is to be a four storied building with about fifty rooms and three or four large laboratories for student investigators From here an ocean going research vessel will operate in the Atlantic The ship 105 feet long at the water line and with a displacement of about 380 tons will be a two master with ketch rigging fitted with an auxiliary Diesel engine Work has already started on this vessel which is being built at Copenhagen The Institution will possess a resident staff of eight or ten workers who will remain at Woods Hole all the year round It is hoped that building will be completed so that the laboratory will be able to open its doors next summer

ON Jan 6 a film on The Sirex Woodwasp and its Parasites was shown privately at the London Pavilion This film is the first attempt at applying the talking film to biological research The wood wasp is responsible for serious havoc to timber, especially in New Zealand This film is to form the first of a series dealing with the habits of the more important Empire forest insects It is to be in

corporated also in the new "Secrets of Nature" series of films, which will be produced this year. Many excellent silent films of scientific subjects, especially relating to natural history, are already available, and the use of the sound film for like purposes is therefore to be welcomed. Educational films are shown in various theatres throughout the country, comprising biology, chemistry, other branches of science, history, and so forth. They are, in some cases, used to make up a complete programme. These, however, are of the popular or very elementary type and, where they from a complete programme, are meant for school children. On the other hand the illustration of a biological or any other scientific subject which one supposes will be of a specialised nature, by means of the sound film, is a different problem. It is too much to expect many members of the general public to pay for performances made up of films of such a nature, so, at the most the films could only be used for filling up a programme of entertainment. The value of the film would thus be seriously diminished. The best use that could be made of such films, the production of which should be encouraged, is for presentation before societies and academic and research institutions. However, much was suggested in this direction with regard to the silent film, but little has yet been done, probably for financial reasons. Nevertheless, the project has a possible future, and its development does not rest so much with production and photography as in securing a sufficient demand to justify producers undertaking the costs involved in making films of this nature.

ON the afternoon of Dec. 18, at the Lister Institute of Preventive Medicine, a large company, consisting of the staff and other research workers, past and present, met in the library of the Institute to offer parting gifts to Sir Charles Martin and Prof. Arthur Harden on the eve of their retirement. Prof. J. C. G. Ledingham, who is succeeding Sir Charles Martin as director, presided, and referred to the fact that only a few years ago a very similar gathering assembled to celebrate the conferment of knighthood on Sir Charles Martin by presenting him with his portrait. Sir Charles had directed the activities of the Institute for twenty-seven years. His highly successful administration might justly be attributed in the first instance, to the great charm of his personality, and secondly, to his tact, his business ability, and the surprising catholicity of his scientific interests. Prof. Harden had served the Institute for thirty-three years and, as biochemist in chief, during that period made his department an important centre of biochemical research. Only a year ago he was awarded a Nobel prize in chemistry for his work on fermentation. While the departure of Sir Charles Martin and Prof. Harden would mean a severe loss to the Institute's forces, the traditions they had set would long remain a potent source of inspiration to their successors. On behalf of the many subscribers at home and abroad, Miss Harriette Chick presented to Sir Charles and Lady Martin a silver coffee service, designed and executed by Mr. Philip Alexander of Walberswick, Suffolk, while Miss Muriel Robertson unveiled and presented to Prof. Harden his portrait in oils by Mr. Neville Lewis. Sir Charles and Lady Martin sailed on Jan. 2 for Cape Town, en route to Australia where Sir Charles will take charge of the Division of Animal Nutrition of the Commonwealth Council for Scientific and Industrial Research for at least two years.

IN a paper reprinted from the *Transactions* of the Indian Philosophical Congress (1927), Mr. J. Walker Tomb declares that 'time' is used in two senses, metaphysical and mathematical. The former is the duration or continuance of personality, depending upon consciousness and memory. The latter, in his opinion, is the duration of matter, and he considers that the definitions of Aristotle, Newton, Einstein, and Eddington are quite wrong. Moreover, "the relativists ... have built upon this misconception a bewildering philosophy which dethrones reason". To support this view, passages are quoted concerning bodies travelling with the velocity of light. (This, of course, is a case in which the equations cease to hold. As Einstein says, "Lumen is a fraud".) It is interesting to compare these views with Sir Arthur Eddington's opinions. In an interview reported by Mr. J. W. N. Sullivan (*Observer*, Dec. 21, 1930), he said: "We must remember that the notion of time, as it occurs in science, is a mere abstraction. The notion of time is, I believe, an abstraction from the dynamic nature of consciousness. Consciousness is essentially dynamic, and the 'time' of science is a most imperfect representation of this quality." The drawing together of science and philosophy is much hindered by the tendency of each side to misunderstand the other.

FOURTEEN of the leading French publishing firms which specialise in the production of technological literature have combined to produce a "Bibliographie des livres français d'Industrie et de Technologie". The lines of the 'Catalogue of British Scientific and Technical Books' of the British Science Guild have been closely followed, with the following difference, namely, that books published in 1929–30 precede the General Catalogue for 1919–30, which forms the bulk of the work. Entries in Part 1 are annotated, those in Part 2 are not. The name and subject indexes include both sections. Hence there is some danger of confusion, and the writer of the prefatory note wisely counsels the user of the Bibliography to consult both sections "en cas de recherche". An annual supplement to the bibliography is promised with a consolidated edition every third year. The classification and indexing of the entries have been carried out in a workmanlike manner, and we have no doubt that the bibliography will prove a useful guide in the selection of French technological books in all parts of the world.

THE north-east of Scotland has many points of contact for the archæologist, the historian, and the naturalist, and each of these, as well as the general reader, will find articles of interest in the latest issue of the *Deeside Field*. Selecting from a wide variety of topics, we mention only the Rev. Dr. Walker's

account of "Some Memorable Naturalists of the North East" He recalls the accomplishments of William MacGillivray, naturalist and ornithologist, George Dickie, botanist, James Nicol, the geologist, who first saw a glimmer of light in the upheavals of the North-west Highlands, of George Sim, taxidermist and naturalist, and Thomas Edward, of Banff, who spent his boyhood in Aberdeen But there are others, for no account could be complete which omitted the name of the Army surgeon, Dr A Leith Adams, who, in addition to writing popular accounts of his natural history observations in India and Egypt, became an authority on fossil elephants

PROF WILLIAM KING GREGORY has been elected president of the Galton Society for the Study of the Origin and Evolution of Man, New York, and Mr Frederick Osborn has been elected secretary-treasurer

A MEETING to inaugurate a British Society of Motion Picture Engineers will be held at the rooms of the Royal Photographic Society, 35 Russell Square, on Monday, Jan 19, at 7 P M A draft constitution has been drawn up by the provisional committee, the secretary of which is Mr Leslie Eveleigh, Gaisford House, Gaisford Street, Kentish Town

THE following advisory committee has been appointed for the purpose of advising the Minister of Health on the practical application of modern advances in the knowledge of nutrition Prof Major Greenwood (chairman), Prof E P Cathcart, Sir F Gowland Hopkins, Miss Jessie Lindsay, Prof E Mellanby, and Prof V H Mottram The members will hold office until Dec 31, 1933, and will be eligible for reappointment The secretary to the committee will be Mr F R Hudson, of the Ministry of Health

THE Council of the Royal Astronomical Society has awarded the gold medal to Prof W de Sitter, director of the Observatory of Leyden, for his theoretical investigations on the orbits of the satellites of Jupiter and his contributions to the theory of relativity Prof de Sitter has also been invited to deliver this year's George Darwin Lecture The Council has awarded a Jackson Gwilt medal and gift to Mr Clyde W Tombaugh, of Lowell Observatory, Flagstaff, Arizona, in recognition of his discovery of the extra-Neptunian planet, Pluto

ON Tuesday next, Jan 20, at 5 15, Mr J W T Walsh will deliver the first of a course of three lectures at the Royal Institution on the art of illumination, on Thursday, Jan 22, at the same hour, Prof H Dingle begins a course of three lectures on the nature of physical science The opening Friday evening discourse of the year will be given by Sir William Bragg, on "The Scattering of Light", on Jan 23, Mr J M Keynes will deliver the Friday evening discourse on Feb 6, on the mechanics of the trade slump

THE Council of the Royal College of Surgeons of England has appointed Mr J H Thompson, lecturer in physiology at King's College, London, to the research scholarship endowed by the late Lord Melchett The subject to which Mr Thompson proposes to devote himself is the influence of the parathyroid bodies on growth His research will be carried out in the new laboratories of the Royal College of Surgeons and also in the physiological department of King's College Mr Wilfred Trotter has been appointed Hunterian Orator of the Royal College of Surgeons for 1932

AT the meeting of the Grand Council of the British Empire Cancer Campaign, held on Jan 12, arrangements were approved in connexion with the Garton Prize of £500 and Gold Medal, which is to be awarded to the person or persons submitting the best original dissertation on "The Early Diagnosis of Cancer" by December 1931 It was also announced that the subject, "The Biological Effects and Mode of Action of Radiations upon Malignant and other Cells", had been chosen for the second Garton Prize and Medal, the dissertations for which must be received by December 1933

THE following appointments have recently been made by the Secretary of State for the Colonies in the colonial agricultural and forestry services Mr G H Gethin Jones to be soil chemist, Kenya, Mr H Evans, to be physiological botanist, Mauritius, Mr M H French, to be biological chemist, animal nutrition research, Tanganyika Territory, Mr R J A W Lever, to be entomologist British Solomon Islands, Mr C O Flemmich, to be assistant conservator of forests Federated Malay States, Mr T E D Vigne, to be assistant conservator of forests Nigeria, Mr C E Duff, to be assistant conservator of forests, Northern Rhodesia, Mr C H Holmes, to be assistant conservator of forests, Ceylon

AT the annual meeting of the Association of British Zoologists, held on Saturday, Jan 10, in the rooms of the Zoological Society of London, with Prof E B Poulton in the chair, the morning session was devoted to discussions as to whether zoologists should accept fees for lectures and expert advice, and on the future of zoological collecting In the afternoon it was moved "that training for applied zoology must be based upon a broad general zoological foundation", the three principal speakers being Dr W T Calman, who dealt with museum work, Dr E S Russell, with fisheries work, and Prof J W Munro, with entomological work The Association has only recently been formed and this was its first meeting, although, for seven years previously, there has been an annual meeting of British zoologists to discuss matters affecting the interests of the science

DR FRANK CONRAD, of the Westinghouse Electric and Manufacturing Co, Pittsburgh, has been awarded the Edison Medal, the highest award of the electrical engineers in the United States, for pioneering work in radio telephone transmission before the days of broadcasting In addition to his developments in radio communication, Dr Conrad has made important contributions to alternating current work and arc lamp design, he has been in the employ of the Westinghouse Co since 1890, and is now assistant chief engineer The Edison Medal was founded by associates and friends of Thomas A Edison and is

given annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts", by a committee of the American Institute of Electrical Engineers

MESSRS W and G Foyle, Ltd, 119 Charing Cross Road, W C 2, have just circulated a catalogue of their No 7 department, containing the titles of books, both second hand and new, relating to most branches of technology and applied science Being carefully classified, the catalogue should be of service to many readers The list is obtainable upon application

APPLICATIONS are invited for the following appointments, on or before the dates mentioned — A research scholar in mental diseases under the Joint Board of Research for Mental Diseases of the University of Birmingham and the City Mental Hospital Committee — E Eyles, Hon Secretary, Council House, Birmingham (Jan 24). An advisory research entomologist at the Seale-Hayne Agricultural College, for the South-West Province—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon (Feb 8) A physicist or engineer to carry out researches and standardisation in wireless telegraphy and telephony, and a physicist to carry out researches in optics, each under the National Research Council of Canada—The Secretary Treasurer, National Research Council, Ottawa, Canada

Our Astronomical Column

The Near Approach of Eros — Prof H N Russell gives, in the *Scientific American* for January, a clear account of the methods being employed for using the present approach of Eros for obtaining improved values of the solar parallax and the mass of the moon He estimates that fully ten years will be needed for a full discussion of the measures but there is one source of delay that he has not considered Several observatories have been co operating during the past six or seven years in obtaining accurate places of selected stars near the planet s track But the track diverges appreciably from the predicted one, to the extent of 1 minute of time in R A at the nearest approach This makes some of the selected stars unsuitable, as being too far from the planet It will be necessary to select others on the opposite side of the planet to take their place, and these will need to be carefully observed One precaution that was not considered in 1901 is now being taken The spectra of the stars have been examined, and those that differ markedly in type from Eros (the spectral type of which resembles that of the sun) will be rejected, owing to the different amount of their refraction by the earth's atmosphere The article notes that the opposition of 1938, though inferior to the present one, will be much better than that of 1901, which was the best since the planet was discovered in 1898 1968 will be about equal to 1938, and the next really favourable oppositions will be in 1975 and 2012

Axial Rotation of Stars —In the *Astrophysical Journal*, vol 72, p 1, Dr O Struve discusses the spectroscopic evidence for the existence of rapidly rotating stars The occurrence of rapid rotations is assumed in many astronomical theories, such as the fission theory of binaries, but so far there has been no direct evidence that they are anything but rare exceptions Dr Struve shows that broad, shallow absorption lines are caused by axial rotation The broadening exhibits the proportionality to wave length required by the Doppler effect, and the line contours agree with the theoretical shapes for rapidly rotating stars There is also a correlation of line width with period and amplitude in spectroscopic binaries Two stars (α Virginis and η Ursæ majoris) are treated in detail, and the evidence suggests the existence of an evolutionary transition between close spectroscopic binaries and rapidly rotating single stars, though the direction of such transition is not established by the observations

Old Eclipses of Jupiter's Satellites —Some of the secular variations of the elements of Jupiter's satellites are so slow that they cannot be satisfactorily determined from recent observations alone All the calculators of tables of the satellites have made some investigations of this kind, that which Prof W de Sitter has lately published in *Annals of Leiden Observatory*, vol 16, part 4, is one of the most complete The earliest observations used are those of Wargentin, beginning in 1668, the extensive list prepared by Delambre in preparation for the construction of his tables has also been used The systematic errors of the observations have been investigated, they are very considerable, but in spite of these a very marked improvement in the secular variations of the elements of satellite III has been obtained in this discussion The improvement is less noticeable in the cases of satellites I and II, as their changes are more rapid and can be determined from the modern observations

Prof de Sitter is much interested in the question of the changes of the earth's rate of rotation, and includes a discussion of the evidence afforded by Jupiter's satellites, the old observations do not add much weight to the determination He considers that the amount of uncertainty of his curve derived from all sources is not more than 5 seconds at the date 1670, the uncertainty from the satellites at the date 1750 is fully 10 seconds

A New Catalogue of the Naked-eye Stars —The Yale University Observatory has published a useful catalogue of 9110 stars, edited by Prof F Schlesinger It contains practically all the stars down to mag 6 5 and a few fainter ones The reference numbers in Boss P G C and in the northern and southern Durchmusterungs are given The positions are given only to the nearest time second in R A and the nearest minute of declination The Proper Motions have been revised and, where possible, are given to the third decimal of a second of arc, those in R A are expressed in great circle The spectral type, parallax, and radial velocity are given, where they are known There is also a column of remarks, which includes notes of companions, of variation of light, or of radial velocity There is also a table for reduction to galactic co ordinates, and one giving the new constellation boundaries as fixed by a committee appointed by the I A U The following systematic corrections have been applied to the proper motions of the P G C

In R A $+0\ 00021^s \quad -0\ 00015^s \sin$ R A $\tan$ Decl
In Decl $-0\ 0023'' \cos$ R A

A bad misprint on page 4 of the introduction should be corrected The R A of the galactic pole is given as $18^h\ 40^m$, it should be $12^h\ 40^m$

Research Items.

Totemism of the Wik-munkan Tribe, Gulf of Carpentaria.—Miss Ursula McConnel continues her study of the Wik-munkan tribes in *Oceania*, vol. 1, pt. 2. Each clan has a number of totems of varying importance which are common to all members of the clan. These are mostly drawn from objects of utility round which daily interest centres, and in the case of natural supplies, from those found in the locality, thus reflecting their economic interests. Thus, totems of the coastal tribes include dugong, sea turtle, sharks, and other fish; 'thunder' which heralds the north-west season, 'high-tide' which brings food, and a 'small bird' which is supposed to guard the fishing operations of a clan; bark canoes and spears, necessary to the success of the hunt; pelicans, geese, pigeons, flying-fox, and so forth. The Wik-mean tribes include milk-wood trees, porcupines, and swamp turtle, all belonging to the Wik-mean country. The totems of other tribes are similarly differentiated according to their economic resources. Dangerous and disagreeable objects also figure in the lists—for example, crocodiles and flies; and objects of social significance such as fire, which is not only useful, but is also the centre of social life as well as the means of disposing of the dead; the bull roarer, and the shooting star or meteor, which is supposed to signify the death of a relative. The 'baby', 'sweetheart', and 'ghost' totems reflect the chief phases of human life—birth, mating, and death. Personal names are derived from the characteristics of the clan totems, or reflect their social value to the clan, sometimes their occupations in association with the totem. Thus, men take their names from the spear handle, women from the fishing net and dilly-bag which they make and use. Women of the dilly bag totem take a special pride in their string work, as if they were mistresses of the art. Or again, women may be called after the crab which they hunt, while men are called after the barramundi fish which they spear. Where totems are animals, women often take their names from the female of the species and its feminine functions.

Dimensions of Flint Implements.—The study of flint implements has in the past been confined to a consideration of the characteristic features displayed by the implements in virtue of the special uses for which they were designed and of the technique employed in making them. Prof. A. S. Barnes (*Proc. Prehistoric Soc. East Anglia*, vol. 6, pt. 2) applies to groups of 100 implements, selected at random, the mathematical methods developed by Galton, Karl Pearson, and others dealing with the characteristics of a crowd or large assemblage of objects, the dimensions used being those of maximum length, breadth, and thickness. It is shown that the 'medians' for length, breadth, and thickness are approximately constant for a given industry and can be used to describe the dimensional characteristics of that industry with precision. Prof. Barnes combines these medians into a single expression which he terms the 'index figure'. The index figure consists of two parts, a whole number and a fraction. The whole number is the median for length, the numerator of the fraction is the product of the medians for breadth and thickness, and the denominator is the median for thickness. Thus an index figure of 61·7 $\frac{544}{13 \cdot 6}$ means that for a group of 100 implements from the industry in question the median length is 61·7 mm., the median cross-sectional area is 544 mm.^{2}, and the thickness is 13·6 mm. It may be urged that the size of the blocks of flint available will influence the size of the implements made from them. From recent measurements made by the author it appears that this is so only to a limited extent, except in rare cases where the raw material available is exceptionally small. For example, the index figure for the Mousterian of Acheulean traditions at Le Moustier itself is 62·2 [illegible], whereas the index figure for implements of the same culture at Combe Capelle, where the raw material is much larger and more abundant than at Le Moustier, is 66 [illegible]. The various methods of measuring closeness of packing of the measures are also described and discussed. The statistical methods employed enable a precise statement to be made of the dimensions of a group of implements in a simple manner, and form a useful adjunct to morphological considerations in determining to which cultural series a group of implements belongs. There are a number of diagrams illustrating the results.

Placentation of the Cony.—Dr. George B. Wislocki gives an account of observations made on the placentation of the cony (*Hyrax capensis*), in vol. 21 of *Contributions to Embryology*, issued by the Carnegie Institution of Washington. The hyrax is usually regarded as having its nearest allies in elephants and hoofed vertebrates, but Dr. Wislocki finds that its placenta differs in structural type from that of the ungulates and resembles that of the insectivores. He also concludes that in its placentation hyrax has many resemblances to that of the much discussed aberrant primate form, *Tarsius*. That there should be a considerable resemblance between the form of placentation of these two aberrant mammals is very remarkable, for they appear to represent different mammalian phyla. Nevertheless both have a disc-shaped placenta which is provided with a dense massive covering of invasive trophoblast. The trophoblast remains poorly vascularised by vessels of fœtal origin. Dr. Wislocki is inclined to regard the form of placentation found in *Hyrax* and *Tarsius* as primitive, while the diffuse placentation of ungulates he would look upon as a later and more fully specialised form. One rejoices to see, in these volumes of *Contributions*, that Mr. Carnegie's benefaction is serving so well the needs of those engaged in embryological research. Under the directorship of Dr. George Streeter a very high ideal has been established amongst the contributors to this valuable publication.

Culturing Insects for Virus Research.—One of the difficulties to be encountered in the rearing of insects for experimental tests of their transmission of virus diseases in plants, is the necessity for maintaining stocks of them free from any possibility of infection. In the *Annals of Applied Biology*, vol. 17, August 1930, Dr. Marion A. Hamilton describes a method for keeping pure and uninfected cultures of aphides and kindred small insects in cages of a special type. These are constructed of a metal framework covered with cellophane and roofed over by means of fine bolting silk. Such cages have the advantage of being portable and freely permeable to light and air. They are, at the same time, proof against the accidental entry of minute forms of insect life, that are commonly so difficult to exclude in experimental work. She further describes a method of rearing aphides apart from their plant hosts. Specially constructed glass capsules were used to contain the feeding medium; these were closed by a membrane of fish skin and then inverted. By this means the aphides (*Myzus persicæ*) were induced to insert their stylets through the fish skin and feed upon artificial media, plant extracts or dyes. Cultured in this way, a certain number lived for six days, and in one case seven days. A longer period of survival may be possible if more suitable media be found.

Genes affecting Chromosome Behaviour—In connexion with the intensive studies of the genetics and cytology of maize, now being carried on at Cornell University, a new genetic factor has been discovered (G W Beadle, *Memoir* 129, Cornell Univ Agric Expt Station), which causes asynapsis, or a failure of the chromosomes to pair in meiosis A similar factor has already been found by Blakeslee in *Datura*, and Gowen has described a condition in *Drosophila* in which there is complete absence of crossing over All these mutations are inherited as simple Mendelian recessives In *Matthiola* a strain with long and another with short heterotypic chromosomes exist, the difference being ascribed to a single Mendelian gene These cases are of special interest in that in each an alteration in the shape or synaptic behaviour of all the chromosomes is due to a single germinal change, which affects the cytological characters but not the phenotypic appearance of the organism, except in so far as it results in sterility The asynaptic strain of maize is almost completely sterile both in pollen and ovules In the pollen meiosis there is no pairing of threads, and in diakinesis 20 univalent chromosomes appear instead of 10 bivalents That the normal attraction between all the chromosome elements should thus be completely inhibited by a single genetic factor is a remarkable fact If such a factor appeared in a species of plant which also reproduced vegetatively, it would lead to a condition of pollen sterility without previous crossing These asynaptic plants, like haploids, occasionally produce viable pollen grains with the unreduced number of chromosomes

Studies of Lactose-fermenting Yeasts and of Moulds of Milk, Cream, and Butter—M Grimes and J Doherty in the routine examination of milk, cream, and butter have isolated two types of yeasts which ferment lactose with gas formation and produce slight acidity in milk (*Sci Proc Roy Dub Soc*, vol 19, No 20, May 1929, p 261) In both types the cells are ovoid, measuring 3 6 μ in length, neither forms spores They appear to be identical with *Torula lactosa*, Harrison, and *T cremoris*, Hammer, isolated from cheese and from cream respectively M Grimes, V C E Kennelly, and H A Cummins in a study of mould fungi found in butter isolated twenty nine species (*ibid*, vol 19, No 47, October, 1930, p 549) Several of the species, while closely resembling, did not altogether conform to type species, and it is suggested that Irish fungi as a result of insularity have developed characters of their own In an examination of moulds from butter, V C E Kennelly and M Grimes report the isolation of a new species of *Paecilomyces* (*ibid*, vol 19, No 44, September 1930, p 513) It is a coremia forming species, with pink spores, it clots milk and partially liquefies gelatin, with evolution of gas and an acid reaction It is named *Paecilomyces hibernicum*

Methods for Fruit Disease Survey—"Epidemic Diseases of Fruit Trees in Illinois, 1922–1928", is the somewhat modest title of a *Bulletin* (Art 3) in vol 18 of the State of Illinois (Department of Registration and Education) Division of the Natural History Survey The paper is by L R Tehon and G L Stout, and these workers summarise the results of six years' work on an intensive survey of fruit tree diseases in their area They have visited a very large number of orchards, making full records, which include accounts of spray treatments and their efficacy, times of application, notes on phenology, and the time and severity of disease incidence It appears from the collected work that pomaceous fruits are usually opposite, in their reaction to a fungus epidemic, to drupaceous fruits, but the main value of the report lies not in the particular conclusions that emerge and which apply to local conditions, but in the careful and exhaustive attempts which have been made to standardise the observations which form the basis for such a survey

The Great Whin Sill—A very important paper by Dr J A Smythe, recording the results of many years' work in the field and laboratory on the group of intrusions known as the Whin Sill, appears in the *Transactions of the Natural History Society of Northumberland, Durham, and Newcastle upon-Tyne*, vol 7, pt 1, pp 16 150 Samples from practically every fresh exposure have been collected, 2950 in all, and two average analyses and ten others, covering the whole area, are presented A large number of specific gravity determinations are recorded These reveal a progressive variation on a regional scale and additional analyses of alkalis (26), FeO (31), and H_2O and CO_2 (28) indicate that the variation is related to slight differences in the composition of the original magma A chemical study of the chief minerals and of micropegmatite makes it possible to calculate the mineral composition of each of the rocks analysed The results agree very closely with the micrometric measurements previously made by Holmes It is shown that the titaniferous black ores cannot be regarded as mixtures of magnetite and ilmenite Analyses are given of seven exceptional rocks ranging through leucocratic varieties to a felsitic type, and these with the normal rocks give a variation diagram closely parallel to that of the normal magma series of Mull A noteworthy feature is the record of five occurrences (all analysed) of fine grained basaltic rocks intrusive into the Whin Sill Only one of the dykes (the Hampeth) associated with the Whin Sill is given detailed treatment, since these were dealt with in a recent paper by Holmes and Harwood (*Min Mag*, p 493, 1928) Alterations due to chloritisation, pectolitisation, vein solutions, and weathering have been closely investigated with the aid of ten new analyses The problem of assimilation is very thoroughly examined, the chemical evidence is entirely unfavourable, and a convincing explanation involving the mode of emplacement is given to account for the puzzling field evidence which drove Clough to face the possibility that assimilation had taken place The paper is one that will provide data for discussion for many years Apart perhaps from the work of Brammall and Harwood on Dartmoor, no limited group of intrusions has ever been so thoroughly investigated

A Low Aurora and its Effect on a Radio Receiver—Though no photographic determination of the height of auroræ has ever yet yielded reliable values below 80 km, cases of auroræ coming much lower, even to the ground, are occasionally reported Mr A C Cummings, Room 1111, 180 Varrick Street, New York, sends us such a report—which also has other unusual features—of an aurora witnessed by his brother at Norwood, Ontario, Canada, early in the winter of 1929–30 He observed that his radio set was 'dead', though the valves were alight and the aerial and ground wires were connected, no reason for the absolute quietness of the set was apparent Looking out, he saw that a bright aurora was in progress, on going outside to get a better view he found, "to his astonishment, that a curtain of streamers extended from the sky to the ground and completely surrounded the house but at a distance of several feet" The curtain was many coloured and unsteady, its scintillations being accompanied by "visible sparking" and by "snapping sounds"

Thermionic Emission—The October number of *Reviews of Modern Physics* contains an article on thermionic emission, by Dr S Dushman In this he has summarised the existing literature on the subject, with, however, special reference to the work of the last ten years This has proceeded partly on the lines of the determination of the emission constants of pure substances, but perhaps most characteristically in the development of composite emitting surfaces, both of the well known type of the thoriated filament, in which monomolecular films of one substance are formed on a base of another, and of the oxide type, coated filaments can now be prepared which will operate in arc tubes, as well as in highly exhausted containers Theoretically, the outlook has naturally been changed by the advent of the new quantum mechanics, which accounts qualitatively for almost all of the phenomena in question, and quantitatively for many of them Dr Dushman remarks with justice that it is difficult at the present time to realise that only sixteen years ago the very existence of a pure electron emission from incandescent solids was questioned by many physicists of good repute

Operating a Loud Speaker without High Tension Circuit—We have received an interesting communication from Dr S R Khastgir, of University College, Colombo One of his students, P U Ratnatunga, has invented a very simple method of operating a loud speaker by means of a diode valve without using a high tension circuit It seems to us that his method is of practical importance It would be useful, for example, in connexion with portable sets, as the usual high tension battery adds appreciably to the weight It would also be useful in connexion with aeroplanes and in military manœuvres The receiver Mr Ratnatunga uses is a single valve receiver which has a diode valve One side of the filament of the diode is directly connected to the earthed point of a tuned aerial circuit The anode of the diode is inductively coupled to the tuned circuit by means of a coil with which the loud speaker is in series, and then goes back to the filament The loud speaker operates at nearly full volume when working Good results were obtained even with an indoor aerial The reception took place about four miles from the receiving station, the power of which was 1 75 kilowatts The resistance of the loud speaker was 2000 ohms and the current through it was only 0 1 of a milliampere When a high tension battery was used the current was 6 milliamperes An ordinary Cossor valve was employed

Dielectric Properties of Ionised Gases—An investigation of the dielectric properties of ionised air described by E V Appleton and E C Childs in the December number of the *Philosophical Magazine* provides a very satisfactory demonstration of some of the properties of the Heaviside layer which are required to account for its action on wireless waves The air was ionised in a glow-discharge at low pressure, and auxiliary electrodes inserted in the discharge tube to form the condenser of an oscillatory circuit The two chief results concern the dielectric constant of the ionised gas, which, for small concentrations of ions, was found to be less than unity, in accord with theory, and the effect of a superposed magnetic field, which, when appropriately oriented and of the right magnitude, was shown to produce a type of resonant spiral motion of the free electrons of the discharge with the same frequency as the oscillations in the condenser circuit In addition, however, Prof Appleton and Mr Childs have found that the thin positive ion sheaths, which form on the condenser plates in the gas when this is heavily ionised, alter completely the capacity of the condenser, the ionised gas between the sheaths acts as a conductor, and the effective capacity is simply that of the two sheaths in series The alteration in the capacity of these sheaths with change in the steady potential applied to the plates follows the law required by Langmuir's theory of exploring electrodes It is of interest to find that the reduction of the dielectric constant below unity was probably detected by the late Prof Barton immediately after the publication of Eccles's theory of the ionic refraction of wireless waves in 1912

Conductivities of Salts in Ethyl Alcohol—The *Journal of the Chemical Society* for November contains some results of measurements of electrical conductivities of uni univalent salts in ethyl alcohol by Murray Rust and Hartley Lithium chloride, nitrate and perchlorate, and sodium and silver perchlorates were investigated The fall in conductivity is proportional to the square root of the equivalent concentration in accordance with the theory of strong electrolytes A comparison of the slopes of the equivalent conductivity $-\sqrt{c}$ curves with the theoretical values calculated from the Debye Huckel-Onsager equation shows that the experimental slope is greater than the theoretical, the percentage deviations from theory varying between 10 and 130 per cent This would be expected if there were any ionic association The range of concentration used was $N/500$ $N/10,000$ The perchlorate ion has a greater mobility than other anions in ethyl alcohol

Activity Coefficients of Salts—There are cases where the activity coefficients of salts deviate considerably from the expected values, and in two papers in the *Journal of the Chemical Society* for November, C W Davies shows that these can be explained on the assumption of incomplete dissociation of the salts concerned When allowance is made for the incomplete dissociation of the added salts, the activity coefficients found for thallous iodate from solubility measurements are no longer abnormal The activity coefficient becomes independent of the nature of the added salt at concentrations, with uni univalent salts, below 0 1 ionic strength The activity coefficient of thallous iodate in the most dilute solutions is expressed by the equation $\log f = A\sqrt{\mu}$, but the value of A is smaller than the value given by Debye and Huckel's theory It appears that this result is general, and also that A may vary from salt to salt Large deviations from the Debye Huckel theory with salts, which have been described as 'electric type' effects, or 'unsymmetrical valency type' effects, are considered to be due wholly to incomplete dissociation of the salts concerned

Keto-Enol Equilibrium—Although the keto enol tautomerism of aceto acetic ester and some of its alkyl derivatives has been previously studied, it is clear that interesting results would be obtained by studying the effect of substituents in the α position, and some experiments are described by Posl and Michalek in the November number of the *Journal of the American Chemical Society* which deal with this problem The α phenyl ester was prepared and was found to contain 28 6 per cent of the enol form The percentages of enol in esters substituted in the α position by methyl, ethyl, and benzyl are 4 1, 0, and 3 4 respectively The values obtained from molecular refractions were entirely different from those with bromine titrations (for example, more than 100 per cent enol was found by the first method as compared with 28 6 per cent by the second), and the chemical method is preferred

Twenty-first Annual Exhibition of the Physical and Optical Societies.

THE twenty first annual exhibition of the Physical and Optical Societies was opened by Sir Arthur Eddington, president of the Physical Society, on Tuesday, Jan 6 Sir Arthur commented on the growth of the exhibition since its inception in 1905, and spoke of the mutual debt of the scientific worker and the instrument maker, saying that progress is making them more and more interdependent All types of apparatus for physical and optical work could be seen at the exhibition, and everyone should find something of particular interest to himself Sir Frank Smith proposed a vote of thanks, and this was seconded by Mr H T Tizard, Rector of the Imperial College, where the exhibition was housed

Electricity has steadily and rapidly taken its place at the foundations of physical science, and one has only to imagine the great reduction which would be effected on removing all electrical instruments to realise the truth of this fact The task of making a selection of interesting items for this article would then become decidedly simplified An interesting feature of this year's exhibition was the wide use made of photoelectric cells Several different kinds were on view, and one of copper oxide on copper, shown by the Westinghouse Brake and Saxby Signal Co, Ltd, operating a relay, merits special comment The Mullard Wireless Service Co, Ltd, was using a photoelectric cell to count the number of visitors to its stand, a beam of light being interrupted by each person as he approached The exhibits of the Gramophone Co, Ltd (H M V), Research Laboratories included a demonstration of the sensitivity of its own cell with a commercial potassium cell The former is of cæsium and of the same type as used in the television apparatus, unlike the copper oxide cell, it is most sensitive to red light An interesting method of measuring the sensitivity of a photoelectric cell by using it to control the output of a 'thyratron' was demonstrated by the British Thomson Houston Co, Ltd The current through the valve was used to drive a direct current motor the speed of which depended on the light falling on the cell, and a loud speaker emitted a note of a frequency dependent on the speed of the motor A photoelectric outfit shown by Messrs Bellingham and Stanley, Ltd, is worthy of mention It is suitable for the photometry of light sources or general spectrometric investigations Provision is made for the variation of the voltage on the cell as well as that on the electrometer plates, and particular care is taken to guard against the interference of external electrical disturbances

The Research Section of the exhibition has always attracted a great deal of well deserved attention, and has expanded considerably since it came into being only a few years ago There is little chance here of being called upon to admire an imposing box with knobs and other protuberances which the writer personally suspects of being either empty or filled with unwanted spare parts Perhaps a hint to exhibitors may not be out of place here Let all apparatus be uncovered on these occasions, even if protection is necessary in general use The physicist loves to see the wheels go round To return to the subject undoubtedly the most popular item in this section was the demonstration of television arranged by the Gramophone Co Ltd (H M V), Research Laboratories During the whole exhibition a crowd was waiting to see what further progress had been made in making the Arabian Nights become fact The definition of the image is good and the colour is also attractive Cinematograph pictures were scanned at the transmitter in five sections of thirty lines each, a lens drum being used to traverse a succession of images over five scanning apertures, and the received image was thrown on to a screen about two feet square The picture was built up of 150 scanning lines and was composed of 15,000 picture elements The frequency needed to give such detail, scanning at 12 times a second, is 23,000 cycles Among the fifteen demonstrations arranged in this section by the National Physical Laboratory, selecting any one for special comment is not easy The Radio Research Board was using a resonant wavemeter circuit to show the existence of side bands when a radio frequency oscillation is modulated by an audio frequency oscillation Messrs L F G Simmons and H C H Townend were demonstrating an interesting method of examining the air flow past models by heating the air in horizontal layers with hot wires The changes in refractive index of the air were used to trace the shape of the flow lines round the body in a shadowgraph Apparatus shown by Messrs F H Schofield and J A Hall was some of that used in establishing the absolute scale of temperature from − 183° C upwards, and included a platinum resistance thermometer, platinum thermocouple, and optical pyrometer Dr Ezer Griffiths had on view a multiple thermo element type hygrometer for distant reading which can be used in a ship's hold An apparatus for measuring the flow through flues was demonstrated by the Gas, Light, and Coke Co (Research and Training Section) The temperature at various points is observed and from the temperature gradient the rate of flow deduced A surprising fact is that the temperature across a section is far from uniform Since the flow of gases is turbulent, this is rather unexpected and opens the field for further work on the subject The Rothamsted Experimental Station showed a bridge for studying the water in soils and the nature of the association of the two, by passing an alternating current and noting the phase angle between this and the electromotive force Not all the water is available for plant life, and vegetation may wither in quite damp soil if the water present is combined with the soil An exhibit illustrating phase-change in tuned circuits, due to the British Thomson Houston Co, Ltd, is worthy of note A fixed primary coil formed the inductance of an oscillating circuit, and a swinging secondary coil was arranged so that the coupling between the two coils was periodically varied As the secondary vibrated the circuits passed through the resonance point and there were alternating attracting and repulsing forces due to sudden phase change The position of the pendulum at which the phase jump occurred was different for the two directions of movement, and this caused a series of impulses which maintained the motion

The Trade Section of the exhibition had many examples of good workmanship, and the optical instruments—especially epidiascopes shown by Messrs Carl Zeiss (London), Ltd, and Messrs W Edwards and Co—may be mentioned in particular Messrs Edwards also demonstrated several kinds of vacuum pumps, one of which—the 'Hypervac' rotary oil pump—will produce a pressure so low as 0 00005 mm The Cambridge Instrument Co, Ltd, exhibited many new instruments, those for use in geophysical surveying being of special interest, and described in Mr Lancaster Jones's discourse on Jan 7 The eight pages in the programme describing these instruments are worth studying The Leakey Harper drawing machine lent by Sir Arthur Keith may also be mentioned In addition to the instruments specified in the programme, Messrs Adam Hilger,

Ltd., showed a Fabry-Perot etalon with variable separation This is a beautifully made apparatus The plates are supported on invar in order to reduce temperature effects to a minimum during long exposures The instrument is suitable for measuring wave lengths in terms of a standard and observing fine structure in the longer wave lengths of the spectrum The Munsell Colour Books, intended to form the basis of a system of colour specification, and X ray gratings prepared in the laboratories of Prof M Siegbahn, were on view, as well as an all metal quartz spectrograph Of special interest to teachers was the astronomical model designed by Mr W Wilson and exhibited by Messrs A Gallenkamp and Co, Ltd, which demonstrates the motion of the earth, moon, and sun Each separate movement can be shown alone and the bodies can be made to perform hypothetical motions This should prove particularly valuable for educational purposes, since the reasons for day and night and seasons will be understood at once on seeing movements which do not produce them Both the M O Valve Co, Ltd, and the Mullard Wireless Service Co, Ltd, had a large selection of transmitting, rectifying, and modulating thermionic valves The M O Valve Co, Ltd, was demonstrating an assembly operation in which the supports for the inside of a valve were bent to the required shape by one movement of a handle

In the section for apprentices and learners started last year some good workmanship was on view In Class A (Craftsmanship) first prizes were awarded to T E Bayley (under eighteen years) of Marconi's Wireless Telegraph Co, Ltd, for a signalling relay, and to H G Freshwater, of Messrs H Tinsley and Co, for a vibrating galvanometer suspension This competitor also obtained the Finsbury prize In Class B (Draughtsmanship), first prizes were taken by W G Hill (under eighteen years), of Messrs H Hughes and Son, Ltd, for a periscope wind gauge bearing plate, and by E G Mansfield, of the General Electric Co, Ltd (Research Laboratories), for a controller for a motor operated rheostat It is to be hoped that this section will continue to grow as time goes on, since the importance of good instruments to the physicist cannot be over estimated

Two discourses were delivered in the large physics lecture theatre, both extremely interesting and very well attended The first, by Mr E Lancaster Jones, was entitled "Searching for Minerals with Scientific Instruments" Mr Lancaster Jones described the four methods used in locating salt deposits, oil, and other minerals, and mentioned the fact that all the instruments which he had in the room were—with only one exception—of British manufacture The four types of instrument used are gravitational, magnetic seismic, and electrical In the first of these methods the instrument measures the value of gravity at different points, and from the variation from normal a mound of denser material than the surrounding earth can be easily located Salt is generally discovered in this way, and its discovery is important, since oil usually occurs with it In the second method the horizontal intensity of the earth's magnetic field is measured, and the existence of magnetic veins disclosed The third method is very interesting An explosion is made at one point, and three sound waves travel to the recording instrument one through the air, one just beneath the ground, and one penetrates the surface as far as a layer of material of different density below ground and then travels along the top of this layer The velocities of sound in air and in the two substances are known, the times of arrival of the waves are recorded by the seismograph and, with the distance of the explosion, all the necessary data for finding the position of the mineral deposit are available The fourth method consists in tracing out lines of equal electrical potential between two electrodes across which an alternating current is passing These lines have a curved shape when copper or similar material exists below the surface The lecture was illustrated by experiments and slides

On Thursday, when the exhibition was open free to the general public, Sir Gilbert Walker gave an interesting account of "Physics in Sport" Sir Gilbert said that the tendency to separate applied mathematics from the happenings of everyday life was to be deplored, and then proceeded to make his audience agree with this statement by giving an explanation of the behaviour of balls He went on to give some idea of the principles involved in such sports as curling, spear throwing, and boomerang throwing The discourse was illustrated by a selection of slides and experiments, the strange behaviour of a coin when rolled on a billiard table causing much amusement

Many hours can be spent at an exhibition of this kind and another visit will still reveal something fresh The secretary is to be congratulated on the success of his organisation The amount of time and thought devoted to making a success of these occasions is scarcely ever realised by those who enjoy its fruits E M COLLINS

Annual Meeting of the Science Masters' Association

THE thirty first annual meeting of the Science Masters' Association was held at the University Edgbaston, Birmingham, on Jan 6 9 The meeting opened during one of the worst fogs on record, but in spite of this more than two hundred members and guests, including the Lord Mayor (Alderman Saunders), were able to find their way to the dinner and the presidential address Altogether more than four hundred members attended the meetings The University buildings are admirably adapted for the purposes of such a conference, and the staffs of the various departments of pure and applied science arranged a very fine series of demonstrations in the laboratories The exhibition of apparatus and books was held in the spacious drawing office, which is an ideal room for the purpose

The presidential address was given by Sir Charles Grant Robertson, Vice Chancellor of the University, who referred to the fact that boys and girls and the young university graduate and teacher of to day fail to realise the immense revolution that has taken place in the world of thought and education during the last fifty years In that period there has been a scientific renaissance comparable in the quality and scope of its range to the humanistic renaissance of the fifteenth and sixteenth centuries The result is that the monopoly of the classical humanists has been overthrown and smashed to pieces, resulting in the admission of other subjects into the school curriculum Sir Charles went on to say that, "confronted with the modern curriculum, Huxley would have insisted that the number of subjects taught is far too large and must be drastically reduced, and for the simple reason that the identification of education with the acquisition of information is an indictable misdemeanour" He (Sir Charles) was profoundly impressed with the ability of undergraduates in the faculties of science, but he often found that they were lacking in general culture Personally he would like to see the training in science continued for every boy

and girl up to the age when they left school, even if it meant for the specialist in humanistic studies some diminution in the school time allotted to the specialist subjects, just as he wanted to see the humanistic culture continued for the specialist in science. In reference to science scholarships, he would like these to be determined by the joint action of teachers in both schools and universities.

In the course of an address on "A Finite Universe?" the Bishop of Birmingham said that over-confident dogmatism during the nineteenth century produced a reaction which has resulted in a spirit of agnosticism in religion. In the present century this has spread to science, so that, at any rate in their better moments, science teachers are none of them dogmatic, not even the youngest of them. It is now recognised that the bases of our knowledge are probabilities, and these to-day threaten to become the ultimates of the physicist. Absolute truth is beyond us, and superstition is the refuge of fools. We shall be wise men if, knowing our ignorance, we search honestly that our understandings may be enlarged, and if, in our search, we never forget that man's intellectual and spiritual faculties are his supreme endowment. On first reflection we feel that the universe must be infinite in extent. Progress as to our understanding of space is due to the mathematician rather than to the metaphysician. Dr. Barnes referred to the following words of Gauss, written in 1824 in regard to what is now known as non-Euclidean geometry: "I think, in spite of the meaningless word-wisdom of the metaphysicians, that we know too little ... about the real meaning of space, to stamp anything as absolutely impossible because it appears unnatural to us." He went on to contrast the basic principles of Euclidean and non-Euclidean geometry and the deductions from each as to the properties of space, saying that it is highly probable that our space is curved and not flat, although at present, possibly owing to the limitations of our minds, we cannot get a concrete picture of what this means. In order to test the validity of this conclusion, mathematicians can devise experiments on the nature of the radiation from distant nebulæ, and the tests so far have indicated that the universe is finite and yet unbounded. He referred to Lemaître's theory of an expanding universe, which has gained the sympathy of astronomers because it seems to offer an explanation of the surprising and perplexing fact that the spiral nebulæ in the depths of space appear to be receding from us with velocities of the order of a thousand miles a second. In conclusion he said that, like Clifford, who was the first man in England to appreciate the significance of Riemann's researches, he found relief from the dreary infinities of flat space in the consoling hope that, after all, the universe may be finite.

A discussion on general science was opened by the chairman, Mr. Fairbrother, of The Cedars School, Leighton Buzzard, who said that general science was proposed by the Association in 1916 as a remedy for what was then called neglect of science. There is a danger that general science should be interpreted as that vague and indefinite type which leads to a nodding acquaintance with many topics of science but to a thorough knowledge of none. Mere snippets are not what the apostles of general science mean to develop. Their aim is to humanise science, to regard man as the central theme of the universe, and to show how man has bent the forces of Nature to his will and how he has made new substances by causing naturally occurring substances and their derivatives to act on one another. General science should cover the whole field of science. Not only should chemistry and physics form an essential part, but also astronomy, physical geography, and elementary biology should be given a place. The teachers of the various branches should be specialists in their own subjects, but the syllabus should be so arranged as to admit of close correlation between one section and another. It must always be remembered that good syllabuses do not necessarily mean good general science, the essence of which lies not so much in the syllabus as in the interpretation of it. Success or failure very largely depends on the outlook of the teacher. It has been suggested that examining bodies do not yet recognise the claims of general science, or give it the dignity of the usual science subjects; but surely that is a matter for the teachers themselves to settle. Let them create the demand and the examining bodies will supply the papers.

The discussion which followed was stimulating and instructive, member after member giving an account of his own course in general science and testifying to the interest aroused in the boys, who are often inspired to continue their studies to greater depths in their own time.

Prof. F. W. Burstall initiated a discussion on "The Science Education of a Boy up to the Age of Eighteen". He said that boys of eighteen who come up to the university have a competent knowledge of science; they can express themselves in clear English and have a fair knowledge of other humanistic studies. When we consider average boys who do not reach university standard, we must divide them into two sections: up to about fourteen and from fourteen to eighteen. Prof. Burstall considers that the young boy can be taught only through his memory, which is the reason why Latin and Greek can be taught him with a considerable degree of success. His view is that the only science taught at this stage should be what is known as Nature study—the description in simple words of the ordinary phenomena of Nature as he observes it in his everyday life. Like all simple subjects, this requires a born teacher to teach it properly. At fourteen the boy's mind is sufficiently developed to enable some science to be taught. Science consists solely of experiment, observation, and deduction, and is therefore by no means a new subject. It has been the study of humanity from the earliest days, when prehistoric man experimented on boring a hole through a flint, and it has been carried on by successive stages to produce our present civilisation. The boy up to fourteen is a young animal who delights in exercising his muscles, who is full of impish mischief and a disinclination to use his mind for any purpose of abstract reasoning. At the same time, he is curious to know how everything works and also the reasons for all the changes he observes in Nature. Prof. Burstall suggested that school science is attractive to the average boy because it gratifies his desire to make something or to change a substance. He urged that the boy should have an outlet for showing his own individuality. Boys differ so much that to attempt to find a curriculum to fit them all is bound to fail. Boys who are stupid in school are only so because they have never had a chance of displaying their faculties. He said that not too much emphasis should be placed on examinations, which, dealing as they do almost entirely with questions of fact, offer a premium to a boy with a good memory and a rapid power of assimilation, but are detrimental to the boy whose mind works slowly.

During the discussion which followed, Prof. H. E. Armstrong expressed his surprise and delight with the discussions he had heard. He was glad to observe that general science is taught in so many schools and that the movement is gaining ground. He disagreed

with Prof Burstall in regard to the boy up to fourteen, up to that age Prof Armstrong considers the boy to be intelligent—it is afterwards that his faculties become blunted

Mr Cameron, Director of Education for Oxford City, gave an account of the work of the Commission on Educational and Cultural Films At the request of the Commission, the Science Masters' Association has already appointed a sub committee to view and criticise films on scientific subjects, and two of those passed by this committee, "The Life of a Plant' and 'The Mechanism of a Motor Car", were shown to a crowded meeting The Association unanimously decided to give the Commission financial support

Mr J Young, in the course of a lecture on "The Lunar Landscape", showed many beautiful slides from photographs taken by his students, he outlined the research which is in progress on the nature and features of the moon's surface

Prof A W Nash gave an address on "The Work of the Physicist and Chemist in the Petroleum Industry", which emphasised the value of applied science There are only two Departments of Oil Technology in the country, one at Birmingham and the other at the Imperial College of Science in London These work in the closest correlation, each tackling different aspects of the petroleum problem

Prof W N Haworth lectured on "Complex Molecular Structures", and Prof Munro Fox showed a series of biological experiments suitable for schools

E N

University and Educational Intelligence.

LONDON —The following doctorates have been awarded *D Sc Degree in Biochemistry* on G F Marrian (University College) for a thesis entitled "The Chemistry of the Oestrin producing Hormone" (*Biochem Jour*, 1929–30) *D Sc Degree in Geology* on R G Hudson (University College) for a thesis entitled "The Lower Carboniferous (Dinantian) of the Craven Reef Belt" (*Proc Geol Assoc* 1930) *D Sc Degree in Physiology* on P Eggleton (University College) for a thesis entitled "The Significance of Creatine Phosphoric Acid in the Mechanism of Muscular Contraction" (*Jour Physiol*, Oct 1930) *D Sc Degree in Statistics* on J O Irwin (University College) for a thesis entitled "Researches in the Theory of Sampling" (*Biometrika*, 1927, *Metron*, 1930)

LIVINGSTONE COLLEGE, Leyton, E 10, which gives courses of instruction to missionaries in the elements of medicine, has issued the annual report and statement of accounts for the year 1929–30 Many former students testify to the value of the instruction they received at the College Income for the year has more than balanced expenditure, and the accumulated deficit has been reduced The deficit, however, still amounts to £758, and structural repairs and replacement of worn out equipment, deferred from year to year have now become urgent A sum of £800 is required to put things in order, and donations are asked for, and may be sent to the Principal, Dr Tom Jays

TEACHER TRAINING principles and methods have been exhaustively investigated during the past two years by a special committee of the Teachers' Training Syndicate of the University of Cambridge The resultant recommendations, recently adopted by the University, emphasise the importance of practical work and of guarding against the tendency of courses in the theory of teaching to produce doctrinaires with but little aptitude for dealing with the ordinary problems of school life It is interesting in this connexion to read the article published in the November issue of *School Life* on "Training Teachers on the Job" This expounds the principles on which the University of North Carolina bases its preference for 'in service' training as compared with training conducted wholly or mainly within a college of education, and describes some of the methods in use A staff of itinerant instructors is employed exclusively on weekly circuits, one day being given by an instructor each week to the members of his classes employed in each of the instructional centres in his circuit He observes throughout each morning all phases of their work and in the afternoon meets them for instruction, which his observations enable him to adapt to individual and group needs While admitting that some courses, such, for example, as those in the history of education or the physiology of the nervous system, can probably be conducted more effectively in residence in the university college of education, the rest—methods and materials in the various subjects, curriculum construction, investigation of educational problems, individual differences, educational measurements, diagnosis and treatment of failures, and the psychology of learning—can it is claimed be given with much greater immediate effect and permanence when taught by the 'in service' method

THE British Broadcasting Corporation has secured the services of many men and women who are eminent specialists in the worlds of art, science, economics, languages, philosophy, and so on, for its several series of broadcast talks from January to April of this year Judging from the pamphlet published in connexion with these series radical changes in the composition of each series have been made For example, the series of talks on "Marriage Past and Present" consists of five lectures by Prof B Malinowski and Dr R Briffault They will take the form of a debate, Prof Malinowski giving the first talk on "The Present Crisis in Marriage and the Historical Background" The second will be given by Dr Briffault Then will follow three talks in the form of a discussion between Prof Malinowski and Dr Briffault, concluding with a recapitulatory talk entitled "What can we learn from all this?" by Prof Malinowski Such a series has much to commend it, but one drawback is its actual seriate form which demands regular attention to such talks—and this is often impossible—if full value is to be obtained from them There are three or four series of talks with a scientific bias, which will be given by single lecturers Mr L F Gibbon is to talk on "Commerce the Peacemaker", Prof A E Heath on "Thinking Ahead", and Prof W Cramp on "Faraday and his Contemporaries" This last is clearly chosen because this year marks the centenary of Faraday's discovery The other series of scientific interest are to take a still different form Each talk in the series will be given by a different person One series, 'What is Science?" seems to have no common basis, the reason for putting them in one group seems to be that the listener is invited to co operate with the speaker in making investigations This is an experiment in what the B B C refers to as "co operative science" Such an attempt is deserving of commendation, but its value may be lessened by the fact that it is based upon the belief that science is now so professional and associated with such forbidding technique that the amateur scientific worker has almost disappeared and with him the journeyman's interest in science However this may be, the B B C is to be congratulated on its attempts to stimulate general interest in science by its varied and original programme

Societies and Academies.

LONDON

Linnean Society, Jan 8 —**E J Salisbury** A study of *Ranunculus parviflorus* L, with special reference to its morphology and ecology The floral structure has been studied in its entirety in 725 flowers, and in a considerably larger number with respect to special features The most frequent number of parts in the flower as a whole is 26 (222 examples) This, with other observations, leads to the conclusion that the total number of parts is a number one less than a multiple of three The structure of the sepals and their variation indicates their origin from leaves, and thus the sepal is the equivalent of the leaf base The staminodal nature of the petals is clearly indicated The petals attain maturity after the stamens, which may be associated with their, phylogenetically, more recent origin The structures of various tissues all suggest a plant of damp rather than dry habitats This is in conformity with the 'atlantic' type of distribution of the species and its southern habitats Experimental cultures show that the species does not grow so well on dry sandy or calcareous soils as on moist loam

PARIS

Academy of Sciences, Dec 1 —The president announced the death of René Blondlot, *Correspondant* for the Section of General Physics —**P Villard** The reduction of the oxygen compounds of phosphorus by hydrogen Phosphoric anhydride and hydrogen commence to react at 700° C, and at about 900° C both red and yellow phosphorus can be collected Phosphorus is similarly produced by the action of hydrogen upon sodium, barium, and calcium pyrophosphates —**J Costantin and P Lebard** Experimental cultures of healthy and degenerated potatoes in the mountains and in the plains The experiments described once more prove the difficulty of procuring healthy tubers working at random and without method Seed potatoes raised in the mountains will propagate disease if the pathological state is not taken into account The superiority, if it exists, will be shown only if healthy varieties are used —Jakob Eriksson was elected *Correspondant* for the Section of Rural Economy in succession to the late M Neumann —**Bertrand Gambier** Anallagmatic invariants of three circles —**Robert Forrer and A Hoffmann** The splitting up of the Curie points of nickel The observations described can be interpreted by assuming the existence of two ferromagnetic substances in nickel each with its own Curie point —**Lucien Amy** The examination of a metal for foreign elements by spectrum analysis The modification proposed gives a marked increase in strength to the lines of magnesium, calcium, and carbon **R Barthélemy** A system of television, including, in particular, an automatic arrangement for synchronisation and setting in phase —**E Darmois and J Cessac** Study of solutions of tartrates in fused calcium chloride, $CaCl_2 + 6H_2O$ —**Mme P Curie** The relation between the emission of long range α rays and of γ rays The theoretical explanation suggested, although not in good agreement with experiment, may still be of service New researches are required to determine more accurately the range of the α rays and the existence and intensity of the groups of γ rays intervening —**J and J F Thovert** The utilisation of photo electric cells with glass envelope for researches on radiations of very short wave length The glass is coated with a layer of vaseline, gelatine, or collodion with which is incorporated a fluorescent substance —**P Chevenard and A Portevin** The mechanism of the reheating of martensite —**F Bourion and E Rouyer** The cryoscopic study of paraldehyde in solutions of sodium chloride and barium chloride —**A Mavrodin** The action of phenyl magnesium bromide on ethyl diethylcyanacetate —**R Brunschwig and L Jacqué** The formation of gums in petrols The colour acquired by a benzol on keeping is not a measure of the gum formation Gum is formed in benzol by the combined action of light and air —**Octave Mengel** Movements of the Quaternary in the Mediterranean Pyrenees —**P Gavaudan** Some vital observations concerning the evolution of the vacuome during spermatogenesis of the Characeæ —**N Lœwenthal** The evolution of the white blood corpuscles in vertebrates —**René Fabre and Henri Simonnet** Contribution to the study of the phenomena of oxido reduction Researches on beer yeast The influence of desiccation The experiments with beer yeast confirm those made with hepatic tissue the hydrosulphide derivatives can only be freed from combination as the result of a traumatism which causes the death of the cell —**Mlle Catherine Veil and Adalbert Van Bogaert** The two heart chronaxies measured selectively according to the direction of the electric current —**H Laugier, W Libersohn, and B Néoussikine** The variations of chronaxy as a function of the position in man —**Régnier and Lespes** The existence of a summer generation in the pilgrim locust, *Schistocerca gregaria* —**L Mercier** A new type of cancer of the lung in mice Heredity and grafting —**E Brumpt** Latent parasitism of *Ixodiphagus caucurtei* in gorged larvæ and fasting nymphs of various Ixodes (*Ixodes ricinus* and *Rhipicephalus sanguineus*) —**Georges Fontes and Lucien Thivolle** Tryptophane and histidine are hæmatogen amino acids —**Mlle S Mouchet** The formation of the non pedunculated spermatophores of the decapod Crustaceans —**C N Dawydoff** The true nature of *Dogelia malayana* —**Mlle Odette Tuzet** The fertilisation of the silica sponge *Cliona viridis* —**Maurice Marie Janot and Jean Laurin** Bulbs of *Allium cepa* and hyperglycæmia

CAPE TOWN

Royal Society of South Africa, Oct 15 —**E Reuning** A contribution to the geology of the western edge of Bushmanland There were morphological conditions on the edge of the plateau immediately anterior to the time of the melting Dwyka ice which, after the subsequent denudation of the Karroo sediments, were re established, and they still form the major part of the morphological structure of this region From the time of the oldest determined sediment of the post Kimberlite period, a practically complete chain of events up to the present is recognisable —**S H Haughton** On a collection of fossil frogs from the clays at Banke, Namaqualand The specimens are part of a large collection discovered in the shales encountered by Dr Reuning when sinking a shaft on the so called 'Arnot' pipe on Banke, Namaqualand There are a number of almost complete skeletons of a fossil frog, to which the name *Eoxenopoides reuningi* is given, A series of stages is described which strengthens the conclusions drawn from living Anura that the whole urostyle is the result of the fusion of a number of vertebræ Evidence as to the age of the clays containing the fossils is almost entirely circumstantial, they must be at least early Tertiary and may be contemporaneous with, or slightly later than, the Dinosaur bearing beds of Kangnas, 40 miles to the north —**M R Levyns** Note on some recent experiments on the germinating capacity of Rhenoster seed Germination tests have been carried out annually since 1925 It has been shown previously that seed which refuses to germinate at the time of shedding

will germinate well a year later Temperatures during the resting period may play an important part in regulating capacity of the seed for germination —**E Reuning** The Pomona quartzite and oyster horizon on the west coast of South Africa north of the Olifants River mouth Ancient phyllites are planed off and covered by a series of deposits which consist of a fossiliferous grit with shark's teeth at the base, followed by a strongly silicified sand and grit passing up into calcified and partly silicified clays Lying unconformably upon these sands and clays—the equivalent of the Pomona quartzite—are marine deposits, divided into the Main Oyster horizon below and the *Donax rogersi* beds above Above these is a terrestrial cover of sand, which has been formed in a discontinuous cycle —**T Levitt** A report on the Cape Flats femur A detailed study of the thigh bone found in a sand quarry on the Cape Flats, in the same circumstances as a skull which has proved to be decidedly primitive The femur shows primitive human and even simian characters, and belonged to an individual appreciably different from any of the existing human types in Africa and definitely low in the human scale This finding corresponds to that arrived at independently for the skull

CRACOW

Polish Academy of Science and Letters, Oct 6 —**Georges Bouligand** Some applications of the theory of ensembles to infinitesimal geometry —**Ladislas Natanson** Certain theorems associated with Fermat's principle —**W Swietoslawski** A differential boiling point apparatus furnished with a fractionating column and its application This apparatus is specially applicable to the study of the purity of liquids either pure substances or azeotropic and eutectic mixtures, and has been designed to handle small quantities of liquids The determination of the amount of water present in an acetone-carbon disulphide azeotropic mixture is given as an example —**J Kozak** and **L Musial** The action of hydantoin on o nitrobenzaldehyde —**J Nowak** Remarks on the age of the magmatic rocks of the uncovered layers of Cieszyn —**J Zerndt** Megaspores arising from a layer situated at a depth of a hundred metres at Libiąż (Stephanian) **Z Grodzinski** The development of the blood vessels in the fore foot of the tortoise (*Emys orbicularis*)

Official Publications Received

BRITISH

Records of the Geological Survey of India Vol 64 Quinquennial Review of the Mineral Production of India for the Years 1924 to 1928 By the Director and Senior Officers of the Geological Survey of India Pp viii+446+xcvi+6 plates (Calcutta Government of India Central Publication Branch) 9 6 rupees 15s 6d

Records of the Indian Museum Vol 31 Appendix List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1929 Pp xx 5 annas, 6d Vol. 32 Part 2 Pp 65 214+plates 2 7 2 12 rupees 5s Vol 32, Part 3 Pp 215 356+plate 8 2 12 rupees 5s (Calcutta Government of India Central Publication Branch)

Memoirs of the Indian Museum Vol 9 No 5 Revision of the Asiatic Species of the Genus *Corbicula* 4 The Species of the Genus *Corbicula* from the Sunda Islands the Celebes and New Guinea By Dr B Prashad Pp. 193 203+plates 24 26 1 6 rupees 2s 3d Vol 11 No 1 Studies on Indian Jassidae (Homoptera). Part 1 Introductory and Description of some New Genera and Species By Hem Singh Pruthi Pp 68+5 plates 5 8 rupees 9s (Calcutta Government of India Central Publication Branch)

The Quarterly *Journal of the Geological, Mining and Metallurgical* Society of India Vol 2, No 4 November Pp 133 179+9 plates (Calcutta) 6 rupees

Education, India Education in India in 1927-28 Pp iv+72 (Calcutta Government of India Central Publication Branch) 1 12 rupees 3s

Malta Annual Report on the Working of the Museum Department during 1929-1930 Pp xviii (Malta Government Printing Office)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 69, No 408, December Pp 120+xxxii (London E and F N Spon, Ltd) 10s 6d

Proceedings of the Canadian Phytopathological Society Inaugural Session December 19 and 20, 1929 Pp. 61 (Ottawa.)

Department of Scientific and Industrial Research Report of the Fuel Research Board for the Year ended 31st March 1930 with Report of the Director of Fuel Research Pp viii+121+8 plates. (London H M Stationery Office) 2s net

Proceedings of the Geologists Association. Edited by A K Wells Vol 41 Part 4 21st December Pp 363 445 (London Edward Stanford Ltd) 5s

Journal of the Society for the Preservation of the Fauna of the Empire New Series Part 12 Pp 66 (London) 1s 6d

Ninth Scientific Report on the Investigations of the Imperial Cancer Research Fund, under the direction of the Royal College of Physicians of London and of the Royal College of Surgeons of England Pp viii+156+39 plates (London Taylor and Francis) 20s

Leeds University Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1929-30 Pp 13 (Leeds)

Department of Scientific and Industrial Research Building Science Abstracts Vol 3 (New Series) No 11 November Abstracts Nos 2039 2182 Pp 379 409 (London H M Stationery Office) 9d net

FOREIGN

Journal of the Faculty of Agriculture Hokkaido Imperial University, Sapporo, Japan Vol 27, Part 2 Das Ausflocken animalischer Eiweissstoffe, von Georg Grasser Über gerbende Stoffe und ihre Beurteilung, Untersuchungen über die tierische Haut Untersuchungen über Gelatine und Haut Beeinflussung der Metallsalz Gelatine Fallung durch Zusatz von Neutralsalzen, Refraktometrische Untersuchung des Chromosäure Reduktion, *von Georg Grasser und Hiroshi Ohoki Gerbereichemische* Untersuchung von Chromosalzen Kombinationswirkung zweier Gerbstoffe gegenüber Gelatine und tierische Haut, ein Beitrag zur chemischen Erforschung der Kombinationsgerbung, von Georg Grasser und Masatake Ichise Pp 227 348 Vol 27 Part 3 Studies on the Ripening of Rice Grains By T Tadokoro and M Abe Pp 349 387 Vol 29 Part 2 Die Apodeminen aus dem japanischen Reich Von H Kono Pp 37 53+Tafeln 5 6 (Tokyo Maruzen Co Ltd)

Ministerio da Agricultura Industria e Commercio Observatorio Nacional do Rio de Janeiro. Boletim Sismologico do Observatorio Nacional 1926 a 1929 Pp 74 (Rio de Janeiro)

Annalen van de Sterrewacht te Leiden Deel 15, Derde Stuk Catalogue of 1172 Reference Stars in the Areas 2 115 of the Systematic Plan of Selected Areas Observations of the Leiden Observatory By C H Hins and J J Raimond, Jr Pp 41 (Haarlem Joh Enschede en Zonen)

Methods and Problems of Medical Education (Eighteenth Series) Pp iv+329 (New York City The Rockefeller Foundation)

U S Department of Agriculture Weather Bureau Instructions to Marine Meteorological Observers Fifth edition (W B No 991) Pp viii+80+8 plates (Washington D C Government Printing Office) 25 cents

Japanese Journal of Geology and Geography Transactions and Abstracts Vol 8 Nos 1 and 2 September Pp iii+112+11 (Tokyo National Research Council of Japan)

University of California Publications in Zoology Vol 35 Vertebrate Natural History of a Section of Northern California through the Lassen Peak Region (Contribution from the Museum of Vertebrate Zoology of the University of California) By Joseph Grinnell Joseph Dixon and Jean M Linsdale Pp v+594 (Berkeley Calif University of California Press)

Transactions of the San Diego Society of Natural History Vol 6, No 14 Four New Birds from Northwestern Mexico By A J van Rossem Pp 213 226 Vol 6, No. 15 A new Least Bittern from Sonora By A J van Rossem Pp 227 228 (San Diego Calif)

United States Department of Agriculture Technical Bulletin No 214 The Physical and Chemical Characteristics of certain American Peat Profiles By Irvin C Feustel and Horace G Byers Pp 27 (Washington D C Government Printing Office) 5 cents

CATALOGUES.

Radiostoleum Pp 14 (London The British Drug Houses Ltd)

Lantern Slides illustrating Zoology Botany Geology, Astronomy &c (Catalogue E) Fifth edition Pp 104 (Manchester Flatters and Garnett Ltd)

Catalogue of Fine Chemical Products for Laboratory Use including Organic and Inorganic Chemicals Analytical Reagents, Standard Stains Indicators (January 1931) Pp. 130 (London The British Drug Houses, Ltd)

Diary of Societies

FRIDAY, JANUARY 16

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section) (Clinical Meeting at Red Cross Clinic for Rheumatism Peto Place N W 1), at 5

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —Dr T L Ibbs and Dr K E Grew The Influence of Low Temperatures on the Thermal Diffusion Effect —Dr J H Vincent Further Experiments on Magnetostriction Oscillators at Radio Frequencies.—S. Butterworth and F D Smith The Equivalent Circuit of the Magnetostriction Oscillator —Dr L C Martin The Theory of the Microscope

BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street) at 5 —Medical Meeting

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at University, Liverpool) at 6 —*Prof* G T Morgan Organic Syntheses facilitated by Pressure (Hurter Memorial Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle-upon Tyne), at 6 —S F Dorey Some Factors influencing the Sizes of Crankshafts for Double acting Diesel Engines

COKE OVEN MANAGERS ASSOCIATION (Midland Section) (at University, Leeds), at 6 30 —H J Hodsman Coke for Domestic Fires

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 — Major W Gregson and others Discussion on Steam versus Oil Engine in the Mercantile Marine

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at Manchester Literary and Philosophical Society, Manchester), at 7 —T H Sanders Locomotive Suspension and its Influence on Derailments.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College), at 7 30 —Dr B. Moore Fused Silica in Industry

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30.—K W Willans Some Problems Surrounding the Reorganisation of an Engineering Works.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (jointly with Tuberculosis Association), at 8 —Discussion The Management of Pregnancy Parturition and the Puerperium in Tuberculous Women Openers Dr G Marshall and Dr M Hiley (Tuberculosis Association) A Bourne and L. C Rivett (Obstetrics and Gynæcology Section)

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section), at 8.30 — Dr G Grant Allan Radiology of the Heart.

SOCIETY OF DYERS AND COLOURISTS (London Section).—J T Holden Researches on the Laundering of Fabrics

SATURDAY, JANUARY 17

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir E Denison Ross Persian Art and Literature (2) The People, the Country, and the Poetry of Persia

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7 15 —R L Quertier Air Compressors

MONDAY, JANUARY 19

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30 —Rev Dr W M Christie The Renaissance of Hebrew

ROYAL GEOGRAPHICAL SOCIETY at 5 —New Types of Survey Instruments —Instr Capt. Baker The 45° Prismatic Astrolabe —Major G Cheetham The Tavistock Theodolite

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof V Bonney The Results and Technique of Myomectomy

BRITISH SOCIETY OF MOTION PICTURE ENGINEERS (at Royal Photographic Society), at 7 —Mr Lance Photo Electric Cells

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at University of Birmingham), at 7 —S G Brown Loud-Speakers since their Conception, with Gramophone Pick ups and Wireless Recording Apparatus

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University) at 7 —E M Payne The Radio—Gramophone Pick up

ROYAL INSTITUTE OF BRITISH ARCHITECTS at 8 30 —Presentation of London Architecture Medal 1929, and Medals and Prizes, 1931

HUNTERIAN SOCIETY OF LONDON (at Apothecaries Hall) at 9 —Dr A Lorand The Problem of Rejuvenation (Hunterian Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Jointly with Institute of Chemistry—Leeds Area Section) (at Leeds) —W H Nuttall Synthetic Resins

TUESDAY, JANUARY 20

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr J W T Walsh The Art of Illumination (1).

ROYAL SOCIETY OF MEDICINE at 5 30 —General Meeting

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —G H Dannatt The Island of Walcheren

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Botany and Biology Section) (jointly with University College Biological Society) (at University College Leicester), at 7 30 —Prof J H Priestley The Growth of a Tree

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub Centre) (at Ericsson Telephones Ltd , Beeston) —T Engblom The Totalisator

WEDNESDAY, JANUARY 21

SOCIETY OF GLASS TECHNOLOGY (at Newcastle-upon Tyne) at 2

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof J B Hume The Pathology of Diaphragmatic Hernia

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5 30 —J R Cowie Metal clad Switchgear

ROYAL MICROSCOPICAL SOCIETY (at B M A House, Tavistock Square) (Annual General Meeting), at 5 30 —Prof R. R. Gates Adaptations in Cellular Structure (Presidential Address)

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Caxton Hall), at 5 30 —T E Lones The South Staffordshire and North Worcestershire Mining District and its Relics of Mining Appliances

BRITISH WOOD PRESERVING ASSOCIATION (at 29 Lincoln s Inn Fields), at 6 30 —Col Sir G L Courthope and others Discussion on The Preservative Treatment of Estate Timber

INSTITUTION OF ELECTRICAL ENGINEERS (Tees side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7 —D B Hoseason The Cooling of Electrical Machines.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub Centre) (at Royal Victoria Hotel, Sheffield), at 7 30.—J Scott MacKenzie The Generation of Electricity by Non Statutory Undertakings.

SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Technical College, Derby), at 7 30 —A. J Hall Fine Structure of Artificial Silks in Relation to Dyeing

ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7 40 — Presentation of the Buchan Prize to Dr C E P Brooks —R. G K Lempfert The Scientific Work of the Meteorological Office, Cardington (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8 30 —M S Briggs Mosques and Minarets —an Introduction to Persian Architecture

ROYAL SOCIETY OF MEDICINE, at 9 15 —Dr A. Chaplin Great Figures in History and Misconceptions removed

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) —Prof C H Desch Crystal Structure and Chemical Action

THURSDAY, JANUARY 22

ROYAL SOCIETY, at 4 30 —Sir Thomas Stanton The Development of a High Speed Wind Channel for Research in External Ballistics.—C Cook The Yield Point and Initial Stages of Plastic Strain in Mild Steel.—P M S Blackett and F C Champion The Scattering of Slow α Particles in Helium

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Prof H Dingle The Nature and Scope of Physical Science (1).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 —E T Norris and F W Taylor High Voltage Testing Equipments —B L Goodlet, F S Edwards, and F R. Perry Dielectric Phenomena at High Voltages

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30 — Squadron Leader W R D Acland Deck Flying

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —Projection of Films

INSTITUTE OF RUBBER INDUSTRY (at "Manchester, Ltd , Manchester), at 7 30 —E H Wallace A Comparison of English and American Technique over the Last Decade

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at College of Technology Leicester), at 8 —Exhibition of Films—(a) Story of Beautiful Colours (b) The Manufacture of Nobel Glasgow High Explosives

INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—J Stewart Malting Barleys of 1930

COKE OVEN MANAGERS' ASSOCIATION (Northern Section) (at Three Tuns Hotel Durham) —S. Tweedy The Variations in the Composition of Crude Benzol under Different Carbonising Conditions

FRIDAY JANUARY 23

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof J W Tudor Thomas Successful Grafting of the Cornea in Rabbits

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —H N Gresley High Pressure Locomotives

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —Short Papers on Various Aspects of Lighting

INSTITUTE OF FUEL (at Institution of Civil Engineers) at 6 30 —Dr K Rummel The Calculation of the Thermal Characteristics of Regenerators (Melchett Lecture)

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas's Café, Swansea) at 7 —Dr R Lessing Recent Improvements in Coal Cleaning

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College Glasgow), at 7 15 —J K Dickie The Coking Industry and its Development in Relation to the Manufacture of Iron and Steel

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —E. W Thompson The Progress and Development of Steam Generators

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir William Bragg The Scattering of Light

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Mining and Industrial Equipments Ltd , Derby) —J C Farrant Modern Grinding

SATURDAY, JANUARY 24

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Dr E Cammaerts Flemish Art (1) The Van Eycks.

PUBLIC LECTURES

FRIDAY, JANUARY 16

UNIVERSITY COLLEGE, at 5 —G P Wells Comparative Physiology (Succeeding Lectures on Jan 23, 30, Feb 6, 13, 20, 27, Mar 6 13, and 20)

MONDAY, JANUARY 19

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr F C Minett Certain Diseases common to Man and Lower Animals

UNIVERSITY OF LEEDS, at 5.15 —Prof A V Hill The Osmotic Pressure of Tissue Fluids

TUESDAY, JANUARY 20

UNIVERSITY COLLEGE, at 3 30 —Dr P Hopkins The Need of Psychologists and the Menace from Charlatans.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15—Dr J A Murray Induction of Cancer by Tar and other Agents. (Succeeding Lecture on Jan 27)

WEDNESDAY, JANUARY 21

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 3 —Prof J W H Eyre Shell fish and the Public Health —At 5 —D S Rabagliati Certain Diseases common to Man and Lower Animals

KING S COLLEGE, LONDON, at 5 30 —Prof A P Newton The Great Age of Discovery (1) The Expansion of the Habitable World

LONDON SCHOOL OF ECONOMICS, at 6.—Dr G P Crowden Muscular Work and Fatigue (Succeeding Lectures on Jan 28 and Feb 4)

BELFAST MUSEUM AND ART GALLERY, at 8.—Prof Walmsley Sand Castles

THURSDAY, JANUARY 22.

UNIVERSITY OF LEEDS, at 8.—L. Ashton Persian Textile Art.

SATURDAY, JANUARY 24, 1931

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Editorial and Publishing Offices

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Standardisation in Industry

IT is now exactly thirty years ago since the British Engineering Standards Association (B E S A) was formed, namely, in 1901, when a small unpretentious committee was set up representing civil, mechanical, and electrical engineering institutions, together with the Iron and Steel Institute and the Institution of Naval Architects It may therefore justly claim to be among the pioneers of the movement towards more uniform and standard methods in industry, including simplification of forms and types, a movement which has now, in all the leading countries, reached vast dimensions and become a factor of supreme significance in industrial efficiency and progress Yet the Association worked for many years in obscurity and discouragement, and did not even receive its Royal Charter of incorporation until 1929, although it had for some time before this received a small grant from the Government This grant, never very substantial, was some time ago reduced to the pitiful allowance of 100 guineas per annum At length, however, the patient and indefatigable labours of the Association are receiving some measure of the recognition that they deserve, it has been promised a greatly increased grant from the British Government, and its work has also been commended by the recent Conference on Standardisation—in connexion with the Imperial Conference of 1930 the report of which has recently been published (Cmd 3716 London H M Stationery Office 3*d*)

This report takes note of two kinds of standardisation, distinguished as (*a*) fundamental standards and (*b*) industrial standardisation The former deals with standardisation of measurement units, and the latter with the rather wider field of industrial simplification and uniformity, and the adoption of standard specifications of material and method in all branches of industry where they can be usefully applied How wide this field is may be gathered from a glance through the rapidly growing list of the B E S A specifications, which now number several hundreds, and are constantly being added to and revised and brought into line with the most improved and up to date methods So much is this the case, indeed, that at its last general meeting the B E S A decided to eliminate the term 'engineering' from its title and all its publications, for it is now generally felt by the Association that 'engineering', despite its vast extent and almost infinite ramifications, is yet not sufficiently comprehensive to cover all the work of

the B E S A The question of a more suitable title is still under consideration, and its solution is not so simple as it looks

Several other important and interesting matters also came up at the last general meeting In the first place, the letter from the Board of Trade announcing the increased Government grant was read, stating that, in view of the recommendations in the final report of the Committee on Industry and Trade, it had been decided to make an annual grant of £3000 as from 1930–31 and for the next four years The Association's annual subscription list brings in about £13,000, and the Board of Trade grant will be increased in the year 1931–32 by £1 for every £3 that the Association may raise in subscriptions from industry in excess of £13,000 in the year ended March 1931, and similarly in the succeeding three years, subject to a maximum total of £5000 from the Government in any one year It is a condition of the grant that the Association will resume and energetically pursue the work of translating British standard specifications into foreign languages, organise local committees in oversea countries, and endeavour to strengthen its connexions with standardising bodies in other parts of the Empire with the view of the advancement of Imperial standardisation The position will be reviewed again by the Government at the end of the period of five years during which the annual grants will be made

The Association needs no exhortation to carry out these conditions, for they have indeed been the essence of its policy for many years, in particular, the work of translating and of co operating to the utmost possible extent, not only with other Empire bodies but also with foreign, has always been in the foreground and has been given the closest attention The chairman, at the last meeting, was in fact able to refer with justifiable pride to the excellence, for example, of the recent Spanish translations, which would greatly facilitate the spread of standardisation not only in Spain but also in the great and rapidly developing communities of South America

By way of exemplifying the tremendous growth and extent of the new fields to be covered, it is only necessary to refer to the comparatively new industries of aviation and wireless In both of these there is almost unlimited scope for standardisation, and already numerous specifications have been agreed upon and published Tentative feelers have been put out also towards the chemical industries and several conferences have been held Hitherto, the work of drafting agreed specifications as a basis for contracts and other purposes has been undertaken by individual industries, very often in collaboration with foreign and Imperial interests in the same industry, as, for example, in the glycerine standards and specifications, but the chairman of the B E S A is of opinion, and says that it has been generally agreed, that the greatest advantages to be obtained from industrial standardisation would be by the co-ordination of all efforts in a single national organisation This, on the face of it, appears a very desirable ideal to aim at, but if, beside national co ordination, one also considers Imperial and foreign co ordination in all fields of industry, then the whole idea becomes almost colossal

Great progress has already been made in the desired direction, but the meetings which have been held during the past year by the Central Committee at the Board of Trade have shown very clearly the difficulties of putting into operation on any extensive scale even a national scheme of simplification, without taking into account the further problems of international collaboration In the national sphere some progress has been made in the building industry, and a very interesting illustration of the Association's widened aims is the recently published specification for the sampling and analysis of small coal, which has been undertaken in co operation with the Fuel Research Board This is the first time that a British standard specification has been brought into ordinary everyday commercial relations with the coal industry, and the result cannot fail to be of national value

The electrical branch of the Association is probably among the most active, especially now that it includes under its ægis the rapidly developing wireless industry and is also growing strongly in other directions In this branch, too, the international aspect has to be very carefully studied During the past year, a largely attended meeting of the International Electrotechnical Commission was held in Scandinavia, when more than fifty British delegates were present, and every attempt is to be made to adopt the recommendations of this Commission in electrical work in Great Britain Similar work is being done in the wireless industry Other directions in which important and interesting work is being done relate to illumination and transport Efforts are being made to evolve a standard for artificial daylight, especially with the view of assisting in colour matching

Generally, the relations of the Association with

the standardising bodies in other countries and oversea dominions, already cordial, are being strengthened and developed, and the recommendations of the Imperial Conference in this matter have been anticipated

The report of the Conference on Standardisation, already referred to, deals, as we have seen, with the two kinds of standardisation, one of which, the industrial, has been briefly considered in connexion with the work of the B E S A The other kind, relating to fundamental standards, is really a constituent part of the wider field of industrial standardisation, for this latter necessarily implies uniform and fundamental standards of measurement

The Conference agreed that Imperial uniformity in these standards is highly desirable, and most of the oversea delegates expressed the view that British standards should be used whenever possible To this end it is necessary (*a*) to provide in each dominion and in India suitable reference standards for each such unit of measurement used in that country, and (*b*) to provide means for comparison with the corresponding standards at the Board of Trade or the National Physical Laboratory , also that at least one member of the Commonwealth should undertake research so that the fundamental standards can be referred ultimately to natural standards, such as the wave-length of light The requisite facilities and organisation for such work already exist or are contemplated in most of the oversea dominions, and it remains for closer co operation to be realised It may therefore be expected that in many parts of the Empire the standards of derived units, such as the volt, ohm, and the units of length in terms of the wave length of light, will soon be realised independently Nevertheless, periodical comparison with the standards in Great Britain should continue, and the report schedules a list of the principal units for which reference standards are likely to be required, with suggested procedure in regard to each

The report is a useful summary of the work done or proposed in reference to standardisation in various parts of the Empire, and while it does not add greatly to the knowledge of those closely engaged in this field or contain any very original suggestions for solving the many formidable difficulties to be encountered, it provides a definite basis for further work on agreed lines Moreover, it bestows an official blessing on what is being done and justifies a hope of wider and more intelligent recognition and support

Morphology of High Molecular Weights.

Der Aufbau der hochpolymeren organischen Naturstoffe auf Grund molekularmorphologischer Betrachtungen Von Kurt H Meyer und H Mark Pp viii + 264 (Leipzig Akademische Verlagsgesellschaft m b H , 1930) 18 gold marks

THE problem of fibre structure has been well to the fore during the last few years, especially in the minds of our German friends, and this really stimulating book is the outcome of their meditations on a subject the interest and importance of which are difficult to over estimate One might almost claim that the study of fibre structure and fibre properties, carried to its logical limit in the study of *molecular fibres*, is comprehensive enough to include most of the physico chemical phenomena of living matter , and because we are in the habit of clothing living matter with once living matter of a fibrous nature, it should be still more easy to substantiate the claim that fibre study is of fundamental importance to industry also At all events, it would seem that this truism has become palatable in Germany, for here we have a book of first rate ' academic ' interest emanating from such an address as ' Ludwigshafen a /Rhein, Hauptlaboratorium der I G Farbenindustrie "

It is scarcely possible to suppress a certain twinge of regret that we of Great Britain, so largely dependent on the success of our textile industries, should have played a comparatively inactive part in the actual structure analysis of natural fibres, in spite of the consolation that is to be gathered from the preface and introductory chapters of "Der Aufbau der hochpolymeren organischen Naturstoffe " The authors state plainly at the outset that their treatment of the subject is based primarily on the Bragg concept of atomic and molecular ' sizes ', and it is clear that the very considerable success that has attended the analysis of cellulose structures arises from the reasoned application of this principle to the Haworth-Freudenberg formula for cellulose The extension of the method to the cases of india-rubber, natural silk, and similar polymerised systems, followed naturally As a matter of fact, model building has long been a helpful pastime in the Bragg school of crystal analysis, even when the more systematic Continental mind tended to view it with a suspicion which subsequent events have proved to be scarcely deserved

The great merit of the volume under review lies

in the attempt to correlate a large amount of physical and chemical information with the results of X-ray analysis, a treatment which serves to show once more that structural crystallography is not simply a branch of chess, but a study of such varied applications and possibilities that it is no longer just to regard it even as a sort of second handmaiden of the sciences It is high time that it took its proper place in our university curricula, so that ideals and aims such as those set forth in the work under notice may attract the attention they deserve and yield their richest returns

When X ray analysis points to a small unit of structure and adds a rider to the effect that the periodicity is sound in only one direction, while physical chemistry insists on a high molecular weight, the inference is that we are dealing with crystals, or pseudo crystals, built up of those typical products of biological activity which the authors call "Hauptvalenzketten On this thesis they have developed an admirable account of the fascinating ascent which leads from the 'ideally perfect' crystal known as diamond, up through the half way house of the long chain paraffins and their derivatives, and on through the synthetic polyoxymethylenes of Staudinger to the complex carbohydrates and proteins, where finally the true crystalline state is lost in the realm of averages and distortions The whole story is pre eminently that of the evolution of the "Haupt valenzkette", even at the risk of offending chemists who might possibly maintain that there is more in protein chemistry than the various permutations and combinations of amino acid chains in simple peptide linkage There are those who are prepared to ascribe some part, at least, of the enormous variety in proteins to certain differences in the type of linkage—but it is good, very good, to emphasise the significance in protein structure of mixed crystallisation and its molecular counterpart, the formation of 'mixed molecules' "Weiter folgt daraus, dass die Bestimmung des Molekulargewichtes aus dem Gehalt des in kleinster Menge vorkommenden Spaltproduktes nicht ohne weiteres brauchbar ist, denn es brauchen nicht alle Moleküle eines Eiweisskorpers auch alle Spaltprodukte zu enthalten, da ja die Voraussetzung, dass alle Moleküle einander gleich sind, nicht mehr gegeben ist" This much, at least, seems clear even from the X-ray analytical data so far available in this field

There can be no hesitation about recommending "Der Aufbau der hochpolymeren organischen Naturstoffe" as a valuable contribution to the literature of both structure analysis and orthodox chemistry The research worker, whether academic or industrial, cannot fail to appreciate its helpful and stimulating qualities and find in it a useful source of reference in a wide range of ideas Above all, there is a very clear account of the X-ray analysis of cellulose and its derivatives, india rubber, natural silk, and certain other proteins, the whole being enriched by the interweaving of such supplementary and explanatory material as requires a table of 346 references

W T ASTBURY

The Great Barrier Reef

A Year on the Great Barrier Reef the Story of Corals and of the Greatest of their Creations By Dr C M Yonge Pp xx + 246 + 70 plates (London and New York G P Putnam's Sons, 1930) 21s net

THE Great Barrier Reef is one of "the wonders of the world", a breakwater built by living organisms extending along 1200 miles of the Queensland coast Its seaward edge varies from 10 to more than 100 miles from the shore, and the barrier is an almost continuous line in the northern half, giving place to a series of isolated reefs to the south On this barrier there are few islets, but the lagoon within is sparsely dotted with sand cays, on one of which, Low Island, Dr Yonge's expedition made its camp The continental coast behind varies, being in many parts high and cliffed, and having off lying islets of volcanic or granitic rock Many parts of it have been carefully surveyed in recent years by Prof Richards and his pupils A bore was also sunk to 600 feet on an islet situated about the middle of the Barrier, but only coral fragments and sand of the regular reef types were obtained Adherents of each theory of coral reef formation have in turn used the Barrier in support of their views, and this divergence of opinion was a clear indication of the need for further research upon the actual building organisms

In these circumstances the Great Barrier Reef Committee of Queensland decided to invite a biological expedition from the old country, and this was arranged by a large committee representing zoology, geology, botany and geography, the Empire Marketing Board, most scientific societies and the University of Cambridge co-operating With Dr Yonge, who undertook experimental work on the nutrition of corals, were F S Russell in charge of plankton, A P Orr (hydrography) Drs T A

Stephenson and S M Manton (coral ecology and life-history), F W Moorhouse (economic animals), S M Marshall (plant plankton), G Tandy (botanist), together with seven volunteer assistants and a party of three geographers With a few black boys and visitors, the camp had to provide for more than twenty persons, while half of the party required laboratory accommodation similar to that in our universities Low Island itself is less than 4 acres, but it is on the edge of a shoal of more than 400 acres, most of which is covered with mangroves or shingle exposed at low tide The seaward reef is largely covered with corals and the whole Barrier is in the East Indian belt, perhaps for marine biology the richest part of the world

Coral anemones are the chief reef builders by means of their elaborate skeletons of lime, which are excellently described and illustrated They paralyse their prey by throwing out stinging cells at passing animals and then engulf them Their whole surface is covered by vibratile hairs (cilia), the main function of which is shown to be the keeping of their surfaces clean They also assist by directing a current of water with its organisms into the coral mouths, out of which all excreta and the coral larvæ are passed by the same means The corals are carnivorous, "vegetable matter is useless to a coral" In the inner cell layer of the coral polyps are countless numbers of tiny round unicellular algæ, which appear to supply oxygen to the corals, while they obtain the normal food materials of plants from their host's excretion In correspondence with these methods of feeding, most corals seem to expand at night and to contract in the day The same system, perhaps, applies to *Heliopora*, *Millepora*, and many other animals allied to the true corals, but we have to await the publication of the author's experimental work The life-histories of corals were studied, the young being extruded from the mouth as planulæ, small masses of cells which float away in the currents These were found to be extruded during the summer at regular intervals of one month "over the period of full moon", but in autumn the intervals increased so that extrusion began to appear "about the period of the new moon" This "lunar periodicity" was better marked in *Chiton*, which, "collected the day before, spawned on the night of full moon" Observations were also made on the rate of growth of corals which were embedded in cement blocks Photographs show an increase in diameter of 40 to 80 per cent in six months

Many other reef inhabitants are described The giant clams are divided into two groups, one of which is seated on the surface of the reef, while the other works its way into the rock, so that the mantle edges look like undulating worms of brilliant hue moving over the reef below This edge was found to be covered with a brown scum of cells similar to the algæ of corals, which here are regarded as playing "an important part in the nutrition of the animal" While some of these "giant cockles" reach a length of 4½ ft—a pair are used as holy water stoops in St Sulpice in Paris and weigh a quarter of a ton—the common burrowing species are quite small, sixteen having been found in an area of 18 inches square Of still more importance is the date stone (Lithophaga), a bivalve which bores by "special glands pouring out an acid" Bêche de-mer, "animated sausages" of large size, continuously shovel sand into their mouths and by triturating it assist in reef destruction They are fished largely by the aborigines of the Torres Strait region, being split open and dried, to be exported afterwards to China for soup The pearl shell industry was already well known, but the *Trochus*, a large coiled mollusc, has only been developed as a result of the War, the total export being probably about 1000 tons, valued at £100,000 The animal grows at the rate of about an inch a year for four years, reaching a maximum of 6 inches, but slowing down after 4 inches It breeds during the winter months, and the adults have quite remarkable powers of hiding away under rocks The sponge industry seems as yet little developed

The description of the work of the expedition on the surface fauna and flora is an excellent account of this line of research, the means by which it is pursued, and the objects sought It is noticeable that there is little fluctuation in the plant plankton during the year, and that the numbers on the average are less than in temperate seas A good point is made in regarding the coral algæ as "imprisoned phytoplankton" intercepting "the nutrient salts which the coral would otherwise excrete into the sea and so increase its fertility" The vertical movements of the plankton were especially studied, the depth of its concentration being all important to the animals which feed upon it There are interesting accounts of the bottom fauna and of visits to Thursday Island, the Torres Straits barrier, and the Capricorn group, but the full record of these must be sought in the scientific publications of the expedition The story is of natural history, and our author, who has a fine journalistic sense,

loves his beasts and applies the biological methods of 1928 to his study of them His book must be read by every student of marine biology, and will be found entertaining by that far wider circle which is interested in the wonders of the world

J STANLEY GARDINER

Archæology from the Air

Ordnance Survey Professional Papers New Series, No 12 *Air Photography for Archaeologists* By O G S Crawford Published by Order of the Director General, Ordnance Survey, under the Authority of the Ministry of Agriculture and Fisheries Pp 44+19 plates (London H M S O , Southampton Ordnance Survey Office, 1929) 4*s* 6*d* net

AIR photography has ceased to be a novelty or a toy, when the Ordnance Survey Office issues a ' professional paper ' for the instruction of archæologists in the reading of air photographs, with hints for airmen also, on the making of such photographs of ancient sites For ' shadow sites ', recorded with the very oblique light of dawn or evening, need different treatment, and yield different results, from bare soil and rocks, best avoided at any time, and from ' crop-sites ' where the growth varies as ancient walls or ditches present either more or less than normal soil or moisture How striking these variations may be, appears from these admirable photographs, despite the elimination of colour-contrast In Nature, they may often be detected by pedestrians , and, as is noted on p 4, this method of archæological survey goes back some way—even further than is stated, for in the reference to Northfield Farm 1904 should be 1894, and the significance of weeds among the corn was suggested by even earlier experience among the tomb-robbing peasantry of Cyprus There the contrast was enhanced by the effects of parching, such as is described on p 5 and it may be noted that Mr Crawford's hopes of " another dry year " were realised in the summer of 1929 Soon, it is hinted, we shall find the normal rotation of crops interrupted by archæological insistence on horse-beans, which have long enough roots to register deep seated antiquity

One of the more remarkable revelations of this air photography is to display the very wide extent of earlier farming Very few tracts have survived altogether untouched , and the question arises, What is the significance of all this, from the points of view of economic history and climatology? Another, not specifically discussed in this memoir, is the marked difference in texture, as seen from the air, of different kinds of grassland, according to the subsoil and geological foundation

What a training in observation, and the significance of things seen, is all this archæological work for the pilots of the Royal Air Force, who have actually taken the photographs! For it is a very different thing to record known objects, however ingeniously devised to be puzzling, and to engage in what is at the same time real research, in the sense that not even the archæological officer knows beforehand what there will be to see , though evidently he has usually a shrewd notion what is worth exploring and what is not

This memoir is an indispensable supplement to the author's " Wessex from the Air ", and the four plates borrowed from that book were worth reprinting for the sake of their present letterpress and the light thrown on them by their present company

J L M

The Position of Women in India

The Key of Progress a Survey of the Status and Conditions of Women in India By several Contributors Edited by A R Caton Pp x + 250 (London Oxford University Press, 1930) 7*s* 6*d* net

MISS CATON and her collaborators have produced a book which is indispensable to the student of Indian problems—social, religious, educational, sanitary, industrial, and political The backward condition of the women in India is one of the root-causes of the backwardness of India as a whole, and the title of the book is taken from a striking sentence in the Simon Report—" the women's movement in India holds the key of progress, and the results it may achieve are incalculably great "

The eight chapters on education, health and sanitation, public life, home and marriage, rural life, industry, and social evils are documented at every point , and the references, which, apart from a few slips of trifling importance, are accurate, give a mass of important facts, skilfully and conveniently arranged

The section on education is largely based on the Report of the Education Committee of the Simon Commission It points out that in British India the percentage of male literates in 1921 (at the last census) was 13 0, of female literates 1 8, and that up to 1921 the discrepancy in literacy between men and women was increasing The discrepancy between the number of boys and girls under instruc-

tion is also increasing. Between 1922 and 1927 the increase in the number of boys under instruction was 2,400,000, the corresponding increase in the number of girls was only 400,000

The obstacles to women's education and all that it means are conservatism in social customs, purdah, and early marriage, and these, with want of education, are the great enemies of women's health in India, and contribute largely to infant mortality Dr A Lankester reported in 1920 that in many cities in India more than twice as many women suffered from phthisis as men Dr K Vaughan, writing in 1928, attributes most of the trouble in child-birth in India to the lack of sunlight due to purdah, with, as its result, osteomalacia and gross pelvic deformity (and it may be added, anæmia) It must, however, be remembered that in large tracts of India, for example, Bombay and Madras, purdah does not prevail (though, except in highly educated circles, the sexes do not mix as in the west) All over India, in spite of recent efforts, the number of skilled doctors and of skilled midwives is small, and the ordinary midwife is desperately inefficient The recent Report of the Age of Consent Committee (1929), of which only one member was European, gives a painful picture of the effects on health of marriage below the age of sixteen It is to be hoped that the new Sarda Marriage Act (which could probably not have been passed but for the Age of Consent Report) may stop the evil—when it is enforced

In turning over the pages of Miss Caton's book it is impossible not to be impressed by the immensity of the work still to be done On the other hand, there has been a real awakening in India, as every recent report shows Discounting a good deal of lip-service (especially on the educational side), we must recognise the existence of a large number of agencies, educational, medical, and social, for the improvement of the conditions of girls and women Indian women themselves, coming from educated and comfortable homes, are now pleading in public the cause of their less fortunate sisters, and some of them have recently occupied conspicuous positions in the world of politics and education The late Begum of Bhopal was Chancellor of the University of Aligarh, and an able Chancellor, Mrs Muthulakshmi Reddi was an extremely active Deputy-President of the Madras Legislative Council But it is in the villages that a change in the position of women is perhaps the most important Mr F L Brayne, who has done so much in the Gurgaon district of the Punjab, writes: "If I might pick out the heart and centre of the uplift campaign, I should say that it was the elevation of the women"

One must not exaggerate Inside many Indian homes, the influence of the woman, and especially the grandmother, has been supreme But the transformation of India, necessary to make her come into line with other countries, will only be possible when the brains of the women are utilised to a far greater extent than at present There is no sign that they are inferior to those of women in the west

P J HARTOG

Our Bookshelf

A Cultural History of the Modern Age the Crisis of the European Soul from the Black Death to the World War By Egon Friedell Translated from the German by Charles Francis Atkinson Vol 1 *Introduction* Book 1 *Renaissance and Reformation, from the Black Death to the Thirty Years' War* Pp ix + 353 + vii (London Alfred A Knopf, 1930) 21s

THIS is an extraordinarily stimulating and attractive book It inclines a reviewer to write far more than his editor could possibly include, for every page either gives provocative pictures of leading figures in the past or else raises profound and eternal questions for discussion The author sets out to give an "incomplete" but artistic presentation of the modern European world to pick out, that is, those features in the modern world which he finds of most significance—especially of spiritual significance He writes well and with enthusiasm Among recent historical works noticed in these columns, the book most like this is Dr Wingfield-Stratford's "History of British Civilisation" What he does for England, Dr Friedell has begun to do in this volume for Europe

One striking point in which the present author differs in his general outlook from Dr Wingfield-Stratford raises one of those great questions which we should like to discuss at length Dr Friedell declares that his is not to be an economic history, and that "economic life, far from being an adequate expression of any culture, does not, strictly speaking, belong to culture at all, only contributing one of its preliminary conditions and not the most vital" So far we might agree with him But when he goes on to treat science as the lowest part of the thinking side of man, inferior to philosophy and far inferior to religion, we feel less confidence in his powers of analysis Science cannot thus be identified with technology and marked off from the sphere of creative thought which embraces art, philosophy, and religion If art is creative in an individual and eternal form which is denied to any particular scientific construction, yet the mental process has common creative elements in both cases, and to treat philosophy and religion as independent of science would, if it were possible, be a still more serious mutilation of the reality of thought

F S M

Handbuch der Experimentalphysik Herausgegeben von W Wien und F Harms Unter Mitarbeit von H Lenz Band 25, Teil 3 *Angewandte Geophysik* Unter der Redaktion von G Angenheister Pp xii + 556 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 54 gold marks

THIS work opens with a short account (48 pages), by H Reich, of the geological foundations on which applied geophysics must build, the remainder of the book consists of small treatises on the various methods, each by a specialist in the method Gravimetric methods are discussed by K Jung (162 pages), the next section, on seismic methods, is divided into two parts, one (of 40 pages), by O Meisser, on 'air seismology', and the other (of 55 pages) on earth seismology, the former, though interesting in itself, seems out of place in the present volume, as it bears on the constitution of the upper atmosphere, and not on that of the earth's interior, to which applied geophysics (as now understood) refers Magnetic methods of prospecting are discussed in 100 pages by H Haalck, and electrical methods by J N Hummel and W Heine, the former dealing with the theory (67 pages) and the latter with the practice (56 pages) J N Hummel also contributes the final section (28 pages) on radioactive methods

The price of the book, 54 gold marks, seems excessive, but will doubtless not deter commercial users, who are those chiefly concerned with the subject, from purchasing a copy Even they, however, may feel that the multiplication of books covering much the same ground can be overdone, especially when at so expensive a rate Some of the joint authors of this volume have recently published fuller accounts, in separate books issued by another publisher, of the sections which they here deal with, the shorter accounts in the present work have the advantage, however, of including mention of the most recent work, with references

Egyptian Civilization its Sumerian Origin and Real Chronology, and Sumerian Origin of Egyptian Hieroglyphs By Dr L A Waddell Pp xx + 223 + 21 plates (London Luzac and Co, 1930) 12*s* 6*d* net

IN this volume, the seventh of the series that Col Waddell has devoted to the exposition of his views on the origin and relations of the great civilisations of antiquity, the author aims at demonstrating the historical character of Menes as an Aryan, a descendant of the first Sumerian or Aryan king who founded civilisation He maintains that Menes was at one and the same time the Sumerian emperor in Mesopotamia and the first dynastic king of Egypt, a crown-colony of his world empire

In a previous volume it has been held that Harappa and Mohenjo Daro are the relics of a Sumerian colony in India Arguing from identifications in the king lists of India, Mesopotamia, and Egypt, it is now maintained that Menes was the son of Sargon, the ruler of an empire extending from India to Britain Egyptian civilisation is made to date from the conquest of the country by the pre-dynastic Pharaohs, now shown to have been Sumerian emperors, the father and grandfather of Sargon, the date of the conquest being about 2780 B C Menes, the crown-prince and governor of the Indus valley, erected Egypt into an independent kingdom, civilised Crete as Minos or Min, and extended his power to the Pillars of Hercules and Britain Col Waddell regards any discrepancy between his theories and those of a more orthodox chronology as due to the weakness of archæological dating, but until he convinces scholars of the accuracy of his identifications—a difficult task, we fear—his own chronology hangs in the air

The Art of Study By Prof T H Pear Pp. vii + 117 (London Kegan Paul and Co, Ltd, 1930) 3*s* 6*d* net

THIS book is the outcome of some broadcast talks to school children on how to concentrate The author has expanded and developed these talks so that they apply not only to school children, but also to children of maturer years who may find they want to study something and yet feel they do not know how to do so

Perhaps nobody but Prof Pear can put abstract psychological problems in such a winning way, the chief difficulty is that the knowledge behind his exposition is so artistically disguised that readers may erroneously believe that the problems involved are really very simple He discusses what we mean by learning, the differences in people with regard to mental make-up so that a method of study useful to one may be a stumbling-block to another, how to form habits of study, how to memorise Interspersed between the facts is much good advice, tendered by one experienced in the difficulties of learners

This book can be recommended as really being what it is called, the art of study, the science of study forms the background

Jorullo the History of the Volcano of Jorullo and the Reclamation of the Devastated District by Animals and Plants By Dr Hans Gadow Pp xviii + 100 + 2 plates (Cambridge At the University Press, 1930) 7*s* 6*d* net

JORULLO stands in an amphitheatre amongst the foothills of the great southern slope of the Mexican plateau It was subjected to a series of eruptions between 1759 and 1775, about five square miles of land being buried and probably at least ten times as much completely devastated The late Dr Gadow, who meditated a larger work on the distribution of animals in Central America, spent a month there and tells the story of the repeopling of the area by plants and animals These penetrated the devastated area at an average rate of a mile in forty years This is slow as compared with Krakatoa, to reach which most organisms must have used sea transport, but this is explained by the situation of Jorullo being in a comparatively dry area We would not care to draw deductions after a month's collecting, but Dr Gadow was unique in his knowledge of the ways of reptiles and amphibians, upon which mainly he bases his views

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Mercury Band System in the Neighbourhood of the Resonance Line

A BAND in the mercury spectrum referred to as 2540 has been the subject of much discussion, owing to its proximity and apparent relationship to the resonance line 2536 52, and to the fact that it is seen in absorption by unexcited mercury vapour of suitable density I have long suspected that this is only one feature of a complicated band system in this neighbourhood The investigation is much embarrassed by the glare of the resonance line, which makes it difficult to photograph delicate details in the immediate vicinity

Recently examining some old spectrograms of a water-cooled mercury arc, I have been able to measure two similar and additional bands between this one and the resonance line The wave lengths are 2540 37, 2538 44, 2537 32 These are shaded *from* the red

In addition, two bands have been measured on the other side of the resonance line at 2535 82 and 2535 35 These are shaded *to* the red

There are faint suggestions of much more, which could probably be made definite if the source were carefully adapted to the purpose Unfortunately, the large spectrograph used was destroyed by fire, which hinders any immediate progress

RAYLEIGH

Terling Place, Chelmsford,
Jan. 12

Methods of Investigating the Intensities of γ-Rays

THERE are two important methods of investigating the intensities of γ-rays, that of Skobeltzyn (*Zeit f Phys*, **43**, 354, 1927 **58**, 595, 1929) and that of Ellis and Aston (*Proc Roy Soc*, A, **129**, 189, 1930) We wish to point out that the results of the measurement of the intensities of the γ rays of radium B and radium C by these two methods are in as good agreement as can be expected

Skobeltzyn's method, which depends on the Compton effect, determines the intensity distribution throughout the spectrum, in the sense that it gives the quantity I_ν when $I_\nu \Delta\nu$ is the aggregate intensity of the γ rays the frequencies of which lie in the interval ν to $\nu + \Delta\nu$ The quantity $\Delta\nu$, in this connexion, is not a differential, but is to be understood as an interval determined by the conditions of the experiment In certain parts of the spectrum where there are two or more strong γ-rays close together, it is not possible to separate their effects, and, as can be seen from col 3 of the following table, the Compton effect method gives the summated intensity (cf Skobeltzyn, loc cit, **58**, 609, Table 2, col 4)

The method used by Ellis and Aston depends on the photoelectric effect, and while there are certain definite disadvantages in the method, it does possess the important advantage of giving the intensities of the individual γ-rays These are shown in col 2 of the table corrected for filtering through 3 5 mm of lead to correspond with the conditions of Skobeltzyn's experiment The ratios of the intensities obtained by the two methods are given in col 4, from which it will be seen that there is on the whole good agreement

To see what can be deduced from this agreement it is necessary to refer briefly to the main features of the measurements Skobeltzyn's method depends on observing by the Wilson cloud method the relative number of electrons ejected within a certain angular range by the Compton effect of the different γ rays. It is generally accepted that the data about absorption

INTENSITIES OF THE γ RAYS OF RADIUM B AND C

$h\nu$ of the γ-rays (volts × 10^{-5})	Intensities by photoelectric method after 3 5 mm lead (I_p)		Intensities by Compton effect method (I_c)	$\frac{I_c}{I_p}$
2 43	0 011			
2 97	0 056	0 22	1	4 5
3 54	0 152			
6 12	0 415	0 46	1 8	3 9
7 73	0 046			
9 41	0 050			
11 30	0 160	0 26	1 19	4 5
12 48	0 050			
17 78	0 22		0 81	3 7
22 19	0 064		0 27	4 2

coefficients needed to deduce the relation intensities of the γ rays is sufficiently well known for purposes such as the present, and that there is no fundamental uncertainty in the method

Ellis and Aston's method, which depends on the photoelectric effect, determines essentially the relative values of the quantities $I_1\tau_1$, $I_2\tau_2$, etc, when I_1, I_2, etc, are the intensities of the γ rays and τ_1 and τ_2, etc, corresponding photoelectric absorption coefficients There is at present no direct experimental evidence about the variation of τ at these high frequencies, and to evaluate the results it was necessary to extrapolate from the X ray region by an empirical formula

The general agreement between the results of the two methods suggests that this extrapolation is approximately correct, and that we have therefore reasonable grounds for accepting the values of the individual intensities of such γ rays as were measured by the photoelectric method

In view of the important part played by the intensities of the γ rays in certain speculations about the structure of radioactive nuclei, we feel it is of interest to point out how these two methods, when combined, yield information which is far more definite than that supplied by either alone The certainty of the Compton effect method supplies just that deficiency in the photoelectric effect method, whilst the latter has the power of dealing with individual γ rays, the lack of which is the chief disadvantage of the Compton effect method A further point which brings out the complementary nature of the two methods is that the photoelectric method is best suited to lower frequency γ rays, whilst the Compton effect method deals, if anything, rather more easily with the higher frequency γ rays

C D ELLIS
D SKOBELTZYN

Uniform Propagation of Flame

MASON and Wheeler,[1] following the initial observation of Mallard and Le Chatelier, considered that when a gaseous explosive mixture is suitably ignited at the open end of a horizontal glass tube, the other end of which is closed, flame travels at a uniform speed for some distance The results of their experiments have been extended further by Wheeler and

his collaborators to the formulation of a speed law,[2] which has since been criticised by Bone, Fraser, and Winter, and interesting experimental evidence brought to disprove the so called speed law[3] At about this time one of us (H K S) was engaged in the determination of ignition temperatures,[4] and came to recognise a certain approximate relation (1 2) between the ignition temperatures and flame temperatures of the mixtures generally studied for the uniform propagation law

From a mathematical analysis (a full account of which is being published elsewhere) we find that a regime of initial uniform flame propagation is *possible*, assuming that pressure plays no part during the short interval of this propagation Our analysis shows that uniform propagation is given by an equality (not by a certain quantity lying between two limits), which of necessity must be delicately balanced It is thus possible that in some mixtures uniform propagation may not exist

The velocity equation developed by us is more rigid than that of Mallard and Le Chatelier and takes note of the distribution of temperature in every section of the gaseous medium comprising the travelling flame For, whilst Mallard and Le Chatelier's formula implies that the gas immediately in front of the flame is at the constant room temperature, and that at the back is merely at the ignition temperature we incline to regard the travelling flame as a region having temperature gradients corresponding with the combustion temperature T, at the rear, and the ignition temperature, θ, at the front, in advance of this there is a

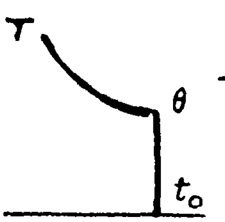

FIG 1
(Mallard and Le Chatelier)

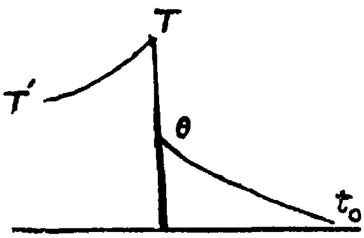

FIG 2
(Sen and Sen)

progressive fall of temperature to that of the cold gas t_0, due to the cumulative effect of the heat generated in the reaction (Fig 1 and Fig 2)

On examining our velocity equation we find that the condition for uniform propagation is $\theta = \frac{aQ}{\rho C}$ where

θ = the ignition temperature,
ρ = density of the inflammable mixture, and
C = specific heat,
aQ = the fraction of the total heat of combustion utilised for conduction

In applying this relationship it must be borne in mind that the flame, the seat of chemical reaction, which in our analysis has been replaced by a mathematical heat source actually possesses a finite width in which the temperature gradient is represented, say, by some curve, ABC in Fig 3

$PCAF$ represents the flame and $FA = \theta$ the ignition temperature In this distribution, account is taken of heat losses

$\frac{aQ}{\rho C}$ then represents the average temperature in the flame, the average being taken with regard to the width AD Moreover, since aQ corresponds to the heat available after combustion, the average temperature here is to be measured above the level of the ignition temperature AD, and is, therefore, given by the area $ABCDA$ divided by the width AD Let BM represent this average temperature given by $\frac{aQ}{\rho C}$ Hence the condition for uniform propagation is that θ, the ignition temperature, should be equal to BM, or, in other words, the average flame temperature should be double the ignition temperature of the combustible mixture The modification of the value of aQ may slightly disturb the condition As stated already, since the distribution of temperature in the flame is intimately connected with the velocity of chemical reaction, the latter may be supposed to be contained in the above condition

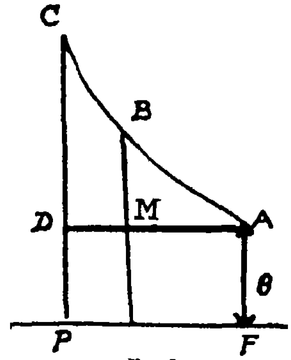

FIG 3

We are in a position to test in a few cases the validity of this relation by comparing the ignition temperature and the flame temperature of uniformly propagating mixtures

	Approximately Instantaneous Ignition Temperatures	Approximate Flame Temperature	
Coal gas	θ	T	T/θ
+ air	880° C	1780°	2 02
Methane			
+ air	* 875°	1670°	1 91
Ethylene			
+ air	1000°	1900°	1 90
Carbonic oxide			
+ air	* 815°	1700°	2 08

* These figures represent the means of those given by Dixon and McDavid

N R SEN
H K SEN

University College of Science,
Calcutta, India

[1] *Trans Chem Soc* 111, pp 1044-1057 1917
[2] Payman and Wheeler *Trans Chem Soc*, 121, 363 79, 1922 Payman *Trans Chem Soc*, 123 412 420, 1923
[3] Faraday Society's Discussions, 1926, also *Proc Roy Soc.*, A, 114, 402-449 1927 *Phil Trans*, A, 228 p 197 1929
[4] Sen and Chatterjee *J Ind Chem Soc*, pp 441 450, 1929

Alternation in Properties of Long Chain Carbon Compounds

ONE of the most interesting features of long chain compounds in the solid state is the well known alternation in properties depending upon whether the chain contains an even or an odd number of carbon atoms The X ray work of Muller on single crystals and of Piper, and Muller and Shearer on the long crystal spacings has shown that long chain compounds crystallise in long zigzag chains lying perpendicular or tilted with regard to the planes formed by the terminal groups It follows at once that there will be a difference between chains containing an odd and an even number of carbon atoms, the terminal groups being respectively in the *cis* and *trans* positions It has been suggested by Pauly[1] and Nekrassow[2] that this is the cause of alternation, and Müller,[3] apparently unaware of this, came independently to the same conclusions

The difficulty with regard to this theory is that it implies alternation in all long chain compounds independent of the tilt of the chain (see Fig 1), whereas, actually, the paraffins, methyl ketones, alcohols, and ethyl esters of mono- and di-basic acids do not alternate It is now suggested by me that the essential

feature of an alternating series is that the zigzag chain is *tilted* with respect to the terminal planes

X-ray and thermochemical[4] work indicates that alternation is due to some difference in the terminal groups, it will be seen from the figure that there is no essential difference in the terminal planes, between odd and even, when the zigzag chain is vertical In tilted chains, however, a difference is at once apparent, alternate terminal planes of odd chains being less closely packed This is readily seen if the distances between penultimate carbon atoms in two chains are considered (a and b in Fig 1), over these different distances the same groups are responsible for holding the molecules together The stability of odd chains will therefore be smaller than that of even, and they will melt at the lower temperatures *

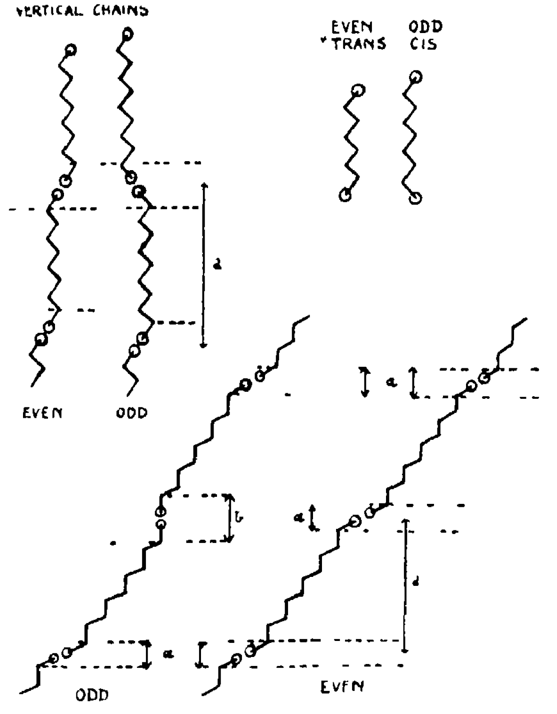

FIG 1—In the above diagrammatic sketch, the discontinuous lines are parallel to terminal planes Circles represent terminal groups d=long crystal spacing ($2d$ in the case of double molecules)

X ray evidence is in agreement with the above suggestion thus, non alternating series possess vertical chains (hydrocarbons, methyl ketones, alcohols), whereas alternating series possess tilted chains (mono and di basic acids, iodides, and nitrils) The following experimental facts are also clear from the figures (1) The long spacings of odd alternating compounds are always slightly greater, in proportion, than the even, whereas in non alternating series odd and even spacings increase linearly (2) The molecular volumes of solid odd fatty acids are greater than those of the even[5] (3) The even alternating series are more tilted than the odd, as was shown in the case of di basic acids[6]

The only apparent exceptions to the above rule are the ethyl esters of mono- and di basic acids, which normally possess tilted chains I now find that ethyl esters of fatty acids possess vertical chains just below the melting points, and although I have not examined esters of di basic acids, it is noteworthy that Normand, Ross, and Henderson[7] observed a second longer spacing for the ester of undecane dicarboxylic acid, which melts just a little above room temperature It seems probable that this longer form would appear generally, for the series, at temperatures not too far removed from the melting points

A detailed account of an investigation of the long spacings of ethyl and methyl esters, showing the alternate forms in which they both exist, together with a fuller discussion of the above, is in preparation It may be mentioned here that methyl esters differ fundamentally from ethyl, behaving in a weaker degree like the acids and crystallising in double molecules with the polar groups together This offers a satisfactory explanation of their anomalous high melting points, since ethyl esters crystallise in layers of single molecules

My best thanks are due to Mr S H Piper for his encouraging interest in the work

T MALKIN

H H Wills Physical Laboratory,
and the Chemistry Department,
University of Bristol,
Dec 27

* The case of the iodides where this is reversed will be discussed elsewhere.

[1] *Zeit f anorg Chemie*, 119, 281, 1921 Pauly also introduces polarity considerations
[2] *Z f phys Chem*, 128, 208 1927
[3] *Proc Roy Soc* A, 124, 318 1929
[4] Garner and Randall, *Jour Chem Soc*, 125, 881, 1924
[5] Garner and Ryder *ibid* 127, 721, 1925
[6] Caspari, *ibid* 3236, 1928
[7] *Ibid* 127 2632, 1925

Optical Investigations on the Passivity of Iron and Steel

SOME results concerning the passivity of metals were described by me recently in NATURE,[1] and afterwards published *in extenso*[2] It may now be of interest to give some new data obtained by means of optical methods These experiments were all carried out by employing mirrors of iron and steel—both ordinary steel and stainless steel—electrolytically treated simultaneously in baths of alkaline, neutral, or acid sodium sulphate solutions Different current densities were used

It is well known that Drude[3] has developed equations which are valid for reflection in air, and by means of these it is possible to compute approximately the mean refractive index and the mean thickness of a surface film from the change in polarisation of the reflected light These equations have now been generalised so as to apply to any medium, and they consequently hold good also for films formed in aqueous solutions

In preparing the metal mirrors, special precautions should be taken to exclude the possibility of any increase in the thickness of the surface film, and I have always attached great importance to this point The constants found by the old methods of preparation are therefore not likely to agree so thoroughly with the true values for the compact metal—free from any 'air-formed' films—as do the optical constants obtained by the method employed in this investigation

According to Bannister and Evans,[4] the process of activation brings about destruction of the 'air formed' film, and thus a definite 'standard state' of the mirror could be obtained after a few minutes On the other hand, destruction of the mirror itself also occurred in some cases

It is remarkable that during the very first time of making the metals passive, all mirrors examined showed a change in the reflected light, which corresponded to the formation of a surface film with a mean refractive index of about 3·0 and a mean thickness of about 30 A The mean refractive index computed in this way agrees with

that of ferric oxide, and from this fact it is evident that the film is actually an oxide film, as demanded by the theory of Faraday Since the optical properties of the mirrors are constant during the process of continuous anodic treatment, independently of the current densities employed, it is further evident that the films should be impenetrable to the constituents of the solution, for example, to atoms or molecules of oxygen The metals are, therefore, made passive in the real sense of the word

As a general rule, reactivation did not completely remove the oxide skin, the destruction of the film on the ferrite grains, however, being more pronounced than that on the cementite grains Thus, by alternating cathodic and anodic treatment (the current was reversed three times in the course of three hours), the oxide film on the cementite particles was microscopically visible as dark brown spots, whereas on the ferrite particles faint yellow interference colours could be detected only by employing slanting incidence According to Evans,[5] the rate of destruction of the films decreases when the solutions are made alkaline, and hence the average thickness of the film is greater in these solutions than in neutral or acid baths

The experimental part of this investigation was carried out in the Metallografiska Institutet, Stockholm, and I wish to thank the Director of the Institute, Prof C Benedicks, for his help and kindness during this time A complete record of all data obtained are to be published in *Det Kgl Norske Videnskabers Selskaps Skrifter*, 1931 (*Transactions of the Royal Society of Science*, Nidaros, Norway)

L TRONSTAD
Norges Tekniske Höiskole,
Nidaros, Norway,
Dec 12

[1] NATURE, 124, 373, 1929
[2] *Zeitschrift für physikalische Chemie*, A, 142, 241, 1929
[3] *Wied Ann Phys*, 36, 532, 865, 1889
[4] *J Chem. Soc*, 1361, 1930
[5] *J Chem Soc*, 478, 1930 NATURE, 126, 130, 1930

Mechanism of Bengal Tornadoes in the Nor'wester Season

THE first requisite of tornado formation is a violent updraught of moist air In a paper on the nor'-westers in Bengal, which will be published shortly, it is being shown from a large number of weather charts that the nor'wester squalls during the period February to June are due to the katabatic flow of air wedges advancing along the valleys and undercutting moist southerly winds over the plains of Bengal In the afternoon when the moist air has attained a certain specified state, conditions become favourable for the formation of squalls near the 'noses' of the valley air-wedges The strength of the squalls increases with the depth of the valley and of the Bay air, and the temperature differences between the two air masses The accompanying diagram (Fig 1) is based on the 13 h I S T chart of April 27, 1930, when a passenger steamer named *Condor* was caught in a violent squall, believed to have been of tornadic violence, and sank at 17 h near Nagarbari

A detailed analysis of daily weather charts shows that the Bay current becomes divergent in the presence of a valley air wedge or barrier In the diagram the divergent moist air stream lines due to wedge-barrier *A*, advancing from the Brahmaputra valley, are the systems *a* and *b*, whilst those due to *B*, advancing from the Cachar valley, are *c* and *d* Of these, the systems *b* and *c* converge along the broken line *PQ*,

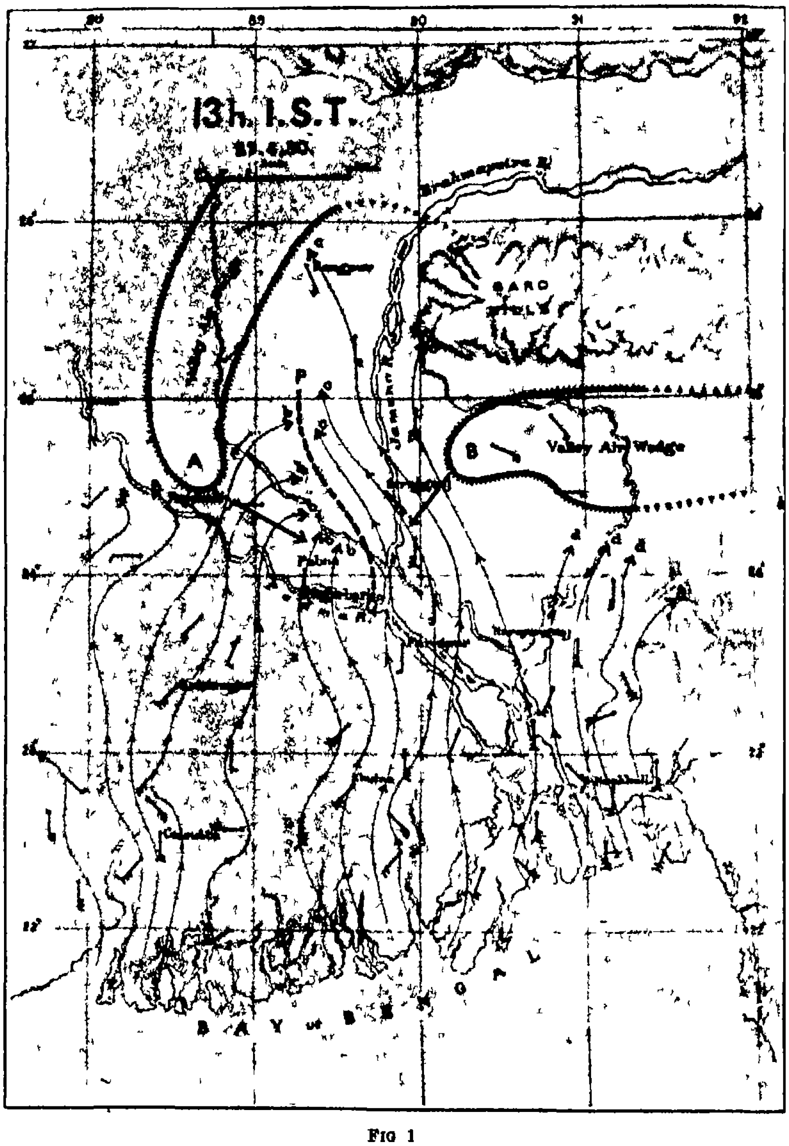

FIG 1

initiating an anti clockwise circulation between the two wedge barriers and consequently an updraught which is probably sufficient for ordinary thunderstorms The directions of motion of the 'noses' of *A* and *B*, indicated by the long thick arrows from the tips of the wedges, were such that the two 'noses' apparently collided with each other (*A* travelling approximately three times as fast as *B*) at Nagarbari, situated approximately at the junction of the two rivers, the Jumna and Padma The upward convection was, therefore,

much accentuated, due to the motion as well as the lateral displacement, slipping, or spreading of the wedge barriers

On the day of the *Condor* disaster the temperature contrast between the valley and the Bay air masses at the surface at 8 h was of the order of 8° or 9° C and their depth between 1 km and 2 km At and above 2 km level there was a westerly or north westerly circulation, wind speed increasing with height, which often carries with it super adiabatic lapse rates favourable to accelerated updraughts (*vide* Roy and Chatterji, NATURE, Sept 28, 1929, p 481) Inversions in the lower layers of the atmosphere over Bengal usually retard updraught of moist air until noon, but this factor often disappears in the afternoon

The above facts suggest that nor'wester thunderstorms can occasionally develop into tornadoes if additional favourable conditions can combine suitably

It appears from preliminary studies that the mechanism of the Bay of Bengal storms is similar to that of the tornado described above The subject is under investigation

S N SEN

The Observatory,
Alipore, Calcutta,
Oct 22

The Latent Photographic Image

IN a recent letter to NATURE (Nov 15, 1930) A P H Trivelli replies to our criticism (*Proc. Roy Soc* A **127**, 613, 1930) of his "elementary voltaic cell" theory of latent image formation, originally put forward by him in 1927 (*J Franklin Inst*, vol 204, 649), and concludes that our criticism is not justified It seems from his letter that he has not realised the significance of our experimental results as they affect his theory We agree with him, of course, that the larger the silver nucleus originally present in the grain, the less is the amount of silver which must be added during the exposure in order that a development centre may be produced, and hence the greater the sensitivity of the grain But quite independently of the absolute mass of silver which (according to Trivelli's theory) must be deposited *electrolytically* during the exposure, his theory demands that the electrolytic current in the light shall be enormously great *relative to its value in the dark* We say this is extremely improbable, mainly because our experiments show that illumination causes little, if any, increase in the electrolytic conductivity of silver bromide

Our second criticism of Trivelli's theory is based on the fact that the electrolytic current in silver bromide falls exponentially with decreasing temperature, being 10^8 times less at the temperature of boiling liquid oxygen than at room temperatures On the other hand, photographic sensitivity at the former temperature is still a large fraction of its value at room temperature Trivelli says, "This objection again ignores the effect of the size of the pre existing speck Only if sensitivity specks were totally absent would the temperature coefficient of photographic sensitivity be comparable with that of electrolytic photoconductance" We cannot agree with this Since the mass of silver deposited in a given time by an electrolytic current depends on the magnitude of the current, a large decrease in current (by lowering the temperature) must necessarily produce a corresponding decrease in the *rate* at which silver is deposited This is a fact which is quite independent of the number of silver atoms which must be added to the original silver nucleus to make a development centre, and which is, therefore, unaffected by the size of the sensitising nucleus Therefore, on Trivelli's theory, the temperature coefficient of photographic sensitivity should, to some extent, be comparable with that of electrolytic conductance

On both these grounds it still seems to us that Trivelli's theory is quite incompatible with our experimental results

F C TOY
G B HARRISON

The Shirley Institute,
Didsbury, Manchester
Dec 12

Structure of Hydrogen Sulphide and Hydrogen Selenide

IN NATURE of Dec 13, p 916, Prof L Vegard communicates the results of the investigation of crystalline structure of hydrogen sulphide and selenide, which were made by him in the Physical Institute of Oslo and finished in July last, while his letter is dated Nov 6

I may be permitted to recall that I have already published two papers on the structure of these substances These papers were presented to the R Accademia dei Lincei in Rome at the meetings of Mar 2 and April 6, 1930, and published in Fasc 7 and 8 of vol 11, 1st sem, pp 679 684, 749 754 Abstracts appeared in NATURE of Sept 6, p 387, and Sept 27, p 495

The data generally agree with those given by Vegard, as for both substances we found a cubic lattice, with face centred distribution for sulphur and selenium atoms For the side of the cell (a) and density of hydrogen sulphide our values are also very similar $a = 5\ 778$ A (N), 5 76 A (V), density = 1 166 (N), 1 17 (V) For hydrogen selenide there is a certain quantitative difference $a = 6\ 020$ A (N), 6 10 A (V), density = 3 45 (N), 2 34 (V), as to the cause of which I cannot for the moment decide, and which I shall investigate further

For the distribution of the hydrogen atoms and the structure of the whole lattice, Vegard considers as most probable space groups T^4 or T_h^6 Considering both substances as ionic compounds, I regard as most probable the space group Oh^5, that is, a fluorite type, which is shown also by lithium sulphide (Claassen, *Rec Trav Chim Pays Bas*, **44**, p 790, 1925)

G NATTA

Laboratorio di Chimica Generale,
R Politecnico, Milan,
Dec 27

Viscosity of Electrolytes

IN NATURE of Dec 27 p 994, there are some general statements as to the viscosity of electrolytes, which are by no means universally true I refer to the statements that 'the relative viscosity of all electrolytes must be greater than unity at high dilutions", and that the phenomenon of 'negative viscosity' will disappear In a paper on the viscosity of aqueous solutions (*Trans Chem Soc*, vol 107, p 1789, 1915) the example of nitric acid is given and the relative principles are discussed It appears that the viscosities depend upon the mutual depolymerisation of the electrolyte and the solvent, and that the resultant behaviour depends on the temperature

At low temperatures, where a large proportion of trihydrol is present, the addition of the electrolyte breaks up so many of the ice molecules that even at high dilution the viscosity of the solution is reduced below that of water The subject is treated at length in the paper to which I have referred

W R BOUSFIELD

St Swithins, Northwood,
Middlesex, Dec 31

Stellar Structure

THE investigation of the structure of the stars, which has for long been a subject of disagreement between Sir James Jeans and Sir Arthur Eddington, has now entered on a new phase through the work of Prof E A Milne A long paper on this matter by Prof Milne, which appears in the November number of the *Monthly Notices of the Royal Astronomical Society* together with related papers by Messrs R H Fowler, N Fairclough, and T G Cowling, was introduced to the Society in November last, but no time was available for discussion The whole of the meeting of the Royal Astronomical Society on Friday, Jan 9, was accordingly devoted to a debate on the subject, which was briefly opened by Prof Milne, and in which many astronomers and mathematicians took part

Prof Milne's views were outlined in NATURE of Jan 3, p 16 In opening the discussion, he stated that the pioneer work in the subject had been done by Sir Arthur Eddington, and what he himself had done was to rationalise Eddington's theory by clearing it of *ad hoc* hypotheses He could not accept Sir James Jeans's theory, because it depended on unlikely extrapolations of the laws of physics He considered that the mass luminosity law which Eddington claimed to have established was not a possible deduction from the fundamental formulæ It could follow only from the addition of a missing equation expressing the unknown dependence on physical conditions of the rate of generation of energy in stars He had, therefore, begun his investigations with observed quantities, representing conditions at the surface of the star, and had worked inwards, without making any assumptions unwarranted by observation

Sir Arthur Eddington, who followed, pointed out that disagreements in physical discussions could be of two kinds first, those which depended on the adoption of different assumptions or hypotheses in the absence of definite knowledge, and secondly, disagreements on the logical or mathematical deductions from given premises He thought that the disagreement between Sir James Jeans and himself was entirely of the first kind, but between Prof Milne and himself there appeared to be a mathematical disagreement, which was very unfortunate He did not approach Prof Milne's latest work in a spirit of opposition He regarded it as quite a permissible attempt to improve the existing theory in points where room for improvement undoubtedly existed The main feature of Milne's picture of the stars was that the mass was largely concentrated in a dense hot core with a surrounding rarefied envelope His own theory gave a much more gradual and uniform increase of density from the centre outwards For the sun it gave a central density of 70, whereas Milne's theory gave a value of about 700,000 The matter there was therefore, according to Milne, not in the condition of a perfect gas, and hence the mass luminosity relation could not be deduced There were certainly loopholes in that relation—it did not apply to a star composed mainly of hydrogen, for example—but he did not believe that Milne's theory had sealed up those loopholes Milne himself had confessedly not been able to satisfy himself that the equations for his stars possessed solutions, and Sir Arthur thought that it was *a priori* unlikely that they did If such solutions existed, however, it still remained to decide between the two widely different central densities This might be done by considering the intrinsic opacity in the interior, or its average if it was variable An appeal on this ground, however, would show that both theories were wrong—that was the long outstanding discrepancy between the physical and astronomical opacities of matter Both theories required a larger opacity than would follow from current physical theory, but he had found that the discrepancy on Milne's theory was far greater than that on his own A great deal depended on how large a mass was concentrated at the centre If it was merely a point source of extremely high temperature and density, with the rest of the star following a distribution of density almost identical with that of his own theory, he might be willing to accept the modification as a useful addition to that theory it would provide a source of stellar energy The large amount of mass, however, which Milne placed around the centre, inevitably made worse the existing discrepancy with regard to the opacity Prof Milne had objected to his theory being called a hypothesis, regarding it rather as an inevitable conclusion It was inevitable only if the premises were granted, and Sir Arthur had been denying them for fourteen years

Sir James Jeans found himself in almost complete agreement with what Sir Arthur Eddington had said, because Sir Arthur had not touched on the points on which they differed If Sir Arthur, Prof Milne, and himself all suddenly became infallible and omnipotent as mathematicians, he and Sir Arthur would still differ on the same points as before, but Prof Milne would agree with one or the other accordingly as he considered the stars to be gaseous inside or otherwise There was nothing new in Milne's theory, all that was accurate in it had been done previously by Eddington or himself He had shown long ago that if you integrated outwards from the centre of a star you got definite results right up to the boundary, but that there an infinite number of solutions were possible, and Nature itself decided which was the actual one When, therefore, Milne reversed the process by integrating from the boundary inwards, it did not matter with which of those solutions his initial data corresponded, he would necessarily arrive at the same conditions in the interior The work, however, would be much more cumbersome He agreed with Eddington about the opacity discrepancy, but considered that the case had not been put strongly enough The factor 10 in the luminosity, by which Eddington's own theory deviated from observation, was much greater than was permissible Expressed in terms of volume, it meant that the sun should be as big

as Antares Since Milne's theory made matters worse still, he considered that that theory was ruled out of court entirely

Dr W M Smart directed attention to the fact that the problem was an idealised one, since we knew nothing at all about the interior of a star from observation Assumptions had to be made, and it should not be forgotten that they were assumptions He considered the stars themselves were the final umpires in the matter Sir Arthur Eddington had suggested the opacity as the criterion by which the umpires gave their decision, he would suggest one of several other criteria Sir James Jeans's theory had been very successful in explaining the formation of spectroscopic binaries by fission, but he did not think that Prof Milne s centrally condensed stars would provide a satisfactory explanation

Prof F A Lindemann hoped that Prof Milne would maintain his theory, because it was the only one which gave really high temperatures in the stars The temperatures required by Sir Arthur Eddington were, on thermodynamical grounds, incapable of permitting the conversion of matter into radiation It was all very well to say that Milne's conclusions were inevitable only if you presupposed something Something had to be presupposed, and Eddington s *ad hoc* assumptions did not meet the facts of the generation of energy He considered that the discrepancy of a million fold in the densities of stars according to Eddington's theory was sufficiently large to make the increase to several million fold in Milne's theory of no significance in deciding between the theories

Sir Oliver Lodge remarked that what struck him most in the discussion was the remarkable agreement between the three protagonists They were agreed on knowledge of fundamental importance which was not available twenty years ago, and, in comparison with that, the differences were unimportant His idea of dealing with the problem would be to start with what we know—the surface temperature of the sun, its rate of generation of energy, the fact that energy comes from the disintegration of atoms Prof Lindemann had assured us that the last named process required a very high temperature Let that temperature at the centre be assumed Then we knew the relation between radiation pressure and gravitational pressure, and with regard to the opacity the Compton effect would give us some information From all these data a mathematician might work out some definite result He was fascinated by Milne's theory of a nova resulting from the collapse of a star Such a possibility had not occurred to him, but it seemed to work out

Several other speakers contributed to the discussion, which concluded with brief comments by Prof Milne He did not agree that his work covered the same ground as Sir James Jeans's He had started from the surface and worked inwards because it was only the surface that we could observe, and he had avoided assumptions which were necessary if you started in an unknown region

Although it could not be said that the discussion led to a greater measure of agreement between the various speakers, it undoubtedly helped, by bringing together different methods of dealing with the question, to focus the nature of the problem more clearly in the minds of those present

Vitamin B

VITAMINS B_2 AND B_3 BIOS

THE possibility of obtaining vitamin B_1 in a relatively pure condition has facilitated the differentiation of the other factors which, with B_1, make up the vitamin B complex Chick and Roscoe used Peters' concentrate to demonstrate that the rat required two factors, the second being known as B_2 or the antipellagrous vitamin More recently, they have published papers dealing with the chemical properties of this factor (*Biochem Jour*, vol 23, pp 504 and 514, 1929 vol 24, p 105, 1930)

Yeast extracts contain vitamin B_2, but the final antineuritic concentrate none examination of the by-products of the concentration showed that about half the B_2 was precipitated by lead acetate, in the treatment of the extract with this reagent (at pH 4 5) and another third in the treatment with baryta and sulphuric acid, the remainder being precipitated during the treatment with acid mercuric sulphate and the subsequent passage of hydrogen sulphide through the filtrate The lead acetate precipitate was the most convenient source for obtaining a concentrated preparation examination of this stage in detail showed that all the vitamin was carried down when the precipitation was carried out at a neutral reaction, but less than half at pH 2 6 The vitamin was recovered by decomposing the precipitate with hydrogen sulphide to ensure precipitation of the lead sulphide at an acid reaction, at which the vitamin is not adsorbed on the precipitate, it was necessary first to hydrolyse the yeast gum in the extract with hydrochloric acid Unfortunately, the lead precipitate also carries down some vitamin B_1, and it was not found possible to obtain a preparation of B_2 free from B_1 by dialysis, by making use of their different solubilities in alcohol or their different rates of destruction by ultra violet light The concentrate was active in a dose of 0 03 gm, equivalent to 0 5 gm dried yeast daily It is possible that yeast extract is an unsuitable medium for effecting a separation Rosedale (*ibid*, vol 21, p 1266, 1927) precipitated from rice polishings extract (by means of lead acetate) a factor which was not B_1, although enabling pigeons to grow and maintain health on a diet of polished rice It cannot yet be said with certainty, however, that this factor is vitamin B_2

B T Narayanan and J C Drummond have also carried out experiments on the concentration of vitamin B_2 (*ibid*, vol 24, p 19, 1930) Yeast

was extracted with dilute alcohol and the extract concentrated; lead acetate was then added, sometimes following a preliminary hydrolysis of the extract with baryta. The lead precipitate was decomposed with sulphuric acid, vitamin B_2 passing into the filtrate. It could be adsorbed on fuller's earth in strongly acid solution, but no satisfactory method of eleuting it again was found. Norite charcoal was not efficient as an adsorbing agent, and its use led to disappearance of the activity.

A certain amount is known about the properties of vitamin B_2: it is soluble in dilute, but insoluble in strong ethyl alcohol, and exposure to the latter results in its destruction. It is stable to hydrogen peroxide and nitrous acid and, to a certain extent, to heat, provided the reaction is acid. Autoclaving or even boiling at an alkaline reaction brings about rapid destruction. It is more easily destroyed by exposure to ultra-violet light than vitamin B_1.

Narayanan and Drummond examined a number of chemical compounds, including nucleic acid, purines, nicotinic acid, betaine and inositol, for vitamin B_2 activity, but all were, without exception, inactive.

V. Reader has adduced evidence that a third factor, tentatively called vitamin B_3, is necessary for the nutrition of the rat (*ibid.*, vol. 23, p. 689, 1929; vol. 24, p. 77, 1930). Animals kept on an apparently complete synthetic diet, in which Peters' concentrate supplied vitamin B_1 and alkaline autoclaved yeast B_2, failed to grow after some weeks; substitution of yeast extract for the two supplements led to an immediate resumption of growth. The failure did not appear to be due to lack of either vitamin B_1 or B_2, since increasing the amounts given did not improve growth. More convincing evidence of the existence of the third factor rests in the fact that it was found to be precipitated by the mercuric sulphate used in the preparation of the B_1 concentrate, and was recoverable, to the extent of 75 per cent of that present in the original extract, from the precipitate. Vitamin B_3 is even more easily destroyed by heat than B_1; under certain conditions it is soluble in ether. Rats fed on an ordinary diet carry a larger store of vitamin B_3 than of B_2; it is, therefore, possible that in short-time growth experiments, such as were used by Chick and Roscoe in the assay of B_1 or B_2, lack of B_3 does not play a part; again, it is also possible that antineuritic concentrates, unless highly purified, or autoclaved yeast, may be contaminated with traces of the third factor.

Chick and Roscoe found that vitamin B_2 was alone present in egg-white, but that rats on a synthetic diet with this material as source of the vitamin instead of autoclaved yeast, showed subnormal growth after a few weeks. They suggest that yeast contains a third B factor, which is, however, thermostable in contradistinction to Reader's B_3. M. A. Boas, some years ago, found that a diet containing dried egg-white produced skin lesions and nervous symptoms in rats, whereas fresh egg-white had no such effect (*Biochem. Jour.*, vol. 21, p. 712, 1927). A number of foodstuffs contained a factor which counteracted the ill effects of the ingestion of dried egg-white; it could not be identified with either vitamin B_1 or B_2.

The above account by no means exhausts the work which has been done on the chemistry of vitamin B. That three or four factors are included under this term appears certain, but it is not easy to relate the work of different investigators, especially when the claim for a new factor is based on the supplementary effects of different foodstuffs. Peters, in his Harben Lectures, reviews some of these investigations. Williams and Waterman found that pigeons maintained their weight on a polished rice diet when supplemented with marmite; transference to wheat, however, produced growth. Hence there is a factor in wheat which is absent from marmite and cannot be B_3. Hunt found that the residue of autolysed yeast, after thorough extraction with water, contained a factor which supplemented two obtainable from the extract; again this third factor does not appear to be B_3, which is soluble in water. Peters has also found that pigeons require for growth, in addition to B_1 and the factor of Williams and Waterman, a thermolabile factor which is present in yeast extract, and may be considered provisionally as identical with B_3; pigeons apparently do not require B_2. It appears, therefore, that the rat requires B_1, B_2, and B_3 with possibly Hunt's factor, whilst the pigeon requires B_1, B_3, and the factor of Williams and Waterman.

It may be of value to refer also to some recent work upon a substance which has been related by many observers to vitamin B, the yeast-growth stimulant or 'Bios'. Confusion was caused by the fact that it was not realised that different yeasts behave differently on various media, that their requirements for bios vary, and that the requirements of other micro-organisms need not necessarily be the same as those of yeast. Peters and his colleagues have investigated the growth factors required by *Streptothrix corallinus* (V. Reader, *Biochem. Jour.*, vol. 22, p. 434; with J. Orr Ewing, pp. 440 and 443; with R. A. Peters and H. W. Kinnersley, p. 445; 1928). When the organism was grown on a synthetic medium, a growth-stimulating factor was found in tryptic beef broth, yeast, rabbit muscle, serum, and wheat embryo; it is organic, soluble in water but not in ether, dialysable, and not precipitated by lead acetate. It accompanies vitamin B_1 in the preparation of the antineuritic concentrate but is stable to alkali in this concentrate (although unstable when crude) and is not, therefore, the same factor as the vitamin. It is synthesised by the *meningococcus*. It is not vitamin B_2. By parallel tests on the organism and on pigeons, it was shown that the factor and vitamin B_1 fractionate quantitatively together through all stages into the final concentrate.

The pitfalls encountered in such work are disclosed by certain anomalous results obtained with this organism, impure preparations of the factor sometimes appearing to contain relatively more growth-promoting activity when used in high concentrations than when used in lesser amounts. Reader has found that this effect can also be pro-

duced by adding mannitol to the purer extracts (*ibid*, vol 23, p 61, 1929) Mannose itself and related alcohols cannot replace mannitol, it appears that the organism uses the alcohol as a specific source of food supply

Working on the relation of bios to yeast, A M Copping (*ibid*, vol 23, p 1050, 1929) has found that the necessity for bios depends on the yeast and the medium used Those which grow in a synthetic medium without the addition of a factor such as is supplied by an autoclaved extract of yeast, produce a stimulant for other yeasts Bios is required by yeasts which only ferment and do not respire in its absence, added bios then stimulates both respiration and fermentation

Narayanan has separated a yeast bios from vitamin B_2 in yeast extract, since the former is not precipitated by lead acetate in the hydrolysed extract (*ibid*, vol 24, p 6, 1930) The bios is not adsorbed on norite charcoal, but is soluble in strong alcohol, it is precipitated by phosphotungstic acid but not by silver or platinic chloride By a series of fractionations a highly active concentrate was obtained The material contained nitrogen but no phosphorus most tests for nitrogenous compounds were negative, but a positive Pauly reaction was obtained It is stable to nitrous acid but destroyed by hydrogen peroxide Narayanan also tested a large number of pure substances, such as nucleic acid, purines, nicotinic acid, betaine, lipoids, and various bases and amino acids for bios activity, but all were found to be inactive

Henry Briggs, 1561–1631

HENRY BRIGGS died three hundred years ago, on Jan 26, 1631 He is famous for his important works on logarithms Napier's first publication of the invention of logarithms, in 1614, had come on the world, as Lord Moulton said, "as a bolt from the blue," breaking in upon human thought abruptly without borrowing from other workers or following known lines of thought Twenty years of persistent effort had been expended by Napier before he arrived at his great discovery, but within far less time than that after its publication the new method of computation was in use in England, France, Germany, and Italy, and its almost immediate adoption for astronomical and other calculations was mainly due to Briggs

Well over fifty years of age when he heard of Napier's work, Briggs made two visits to Scotland to see Napier, and the remainder of his life was almost entirely devoted to the compilation of his three works, "Logarithmorum Chilias Prima", 1617, "Arithmetica Logarithmica", 1624, and "Trigonometria Britannica", 1633 The first of these contained the logarithms of the first thousand natural numbers calculated to eight decimal places, in the second, he gave the logarithms of 30,000 natural numbers to fourteen places of decimals, while the third work, completed after his death by his friend Gellibrand, contained tables of logarithms of sines and tangents carried to the hundredth part of a degree and a table of natural tangents, sines, and secants The labours involved in these works have placed Briggs among the most industrious of men and the benefactors of mankind

Had Briggs never heard of Napier's invention and had he not taken a leading part in spreading abroad a knowledge of logarithms, he would still be remembered as one of the outstanding British mathematicians of his day, for he was the first to hold the Gresham professorship of geometry in London and the Savilian professorship of geometry at Oxford In a city rich in scientific associations the name of Sir Thomas Gresham (1519–1579) will always be connected with the foundation of the Royal Exchange and of Gresham College, from the latter of which, in other circumstances, might well have sprung a great university of London A visitor to-day leaving St Helen's Church—the Westminster Abbey of the City—where Gresham is buried, passes into a busy centre of finance and commerce Three hundred years ago it was not so, for just opposite the church stood the entrance gates to Gresham's mansion, which, by a will made in 1575, he bequeathed to the Mayor and citizens of London for the use of seven professors, who were to read daily lectures on astronomy, music, geometry, law, physic, rhetoric, and divinity Confirmed by an Act of Parliament, on the decease of Lady Ann Gresham the bequest became available, and in 1596 the chair of astronomy was bestowed upon Edward Brerewood (1565–1613), of Brasenose College, Oxford, while Briggs was appointed to the chair of geometry

Briggs was then thirty five years of age Born at Warleywood, near Halifax, Yorkshire, in 1561, he attended a grammar school in the district, and in 1577 entered St John's College, Cambridge He became a scholar in 1579, took the degree of B A in 1582, that of M A in 1585, and was elected a fellow in 1588 In 1592 he was made examiner and lecturer in mathematics, and for a time held the lectureship in physics founded by Linacre

Removing to London in 1596, like the other Gresham professors he occupied "commodious and comfortable" apartments in Gresham's house, and, with his colleagues, began delivering those lectures which were given, we are told, "to the great delight of many, both learned and lovers of learning" Some idea of Gresham's house, with its reading hall, its observatory, its galleries, its colonnade, and its great quadrangle, can be obtained from the sketch in Ward's "Lives of the Professors of Gresham College" For more than a century and a half it sheltered the professors and for half a century it was the home of the Royal Society, but to-day nothing of it remains The Royal Society removed its headquarters to Crane Court, at the other end of the City, in 1710, the interest in the lectures diminished, the buildings became dilapidated, and in 1767 "for the poor sum of 500£ per annum the trustees agreed to demolish the College and to part with all the land [the property really of the public] for the very unphilosophical purposes of an Excise office"

After this, lectures were given in the Royal Exchange until 1843, when a special building was erected and this in 1913 was replaced by the handsome Gresham College in Gresham Street, where the present Gresham professors continue the work which was inaugurated more than three centuries ago by Briggs and his fellow workers

In 1620, Briggs removed to Oxford as Savilian professor of geometry, at the invitation of Sir Henry Savile (1549–1622) Savile himself had already read thirteen lectures upon the first eight propositions of Euclid's "Elements", and Briggs began his own lectures with the ninth proposition His teaching, however, was of secondary importance to his compilation of logarithmic tables, and it was largely due to the leisure he enjoyed at Oxford that he was able to accomplish so much "A contemner of riches, and contented with his own station, preferring a studious retirement to all the splendid circumstances of life", his close habits of study did not prevent him gaining the good opinion of his contemporaries, one of whom, William Oughtred, called him 'the Mirror of the Age" Briggs's long and useful life came to an end when he was nearly seventy years of age, and he was buried beside Savile in the chapel of Merton College, "a plain Stone being laid over him, with his Name only inscribed on it"

Obituary.

DR J W EVANS, C B E, F R S

BY the unexpected death of John William Evans on Nov 16 last geological science has lost an indefatigable worker and writer, and many geologists a valued teacher, colleague, or friend Born in 1857 and educated at University College School and College, he took the LL B of the University of London and he was called to the Bar in 1878 He turned, however, to science and joined the Royal College of Science, where he studied under Judd and Cole, and was one of a brilliant group of students that included Holland, Wells Davies, and Lanchester He was awarded the Murchison Medal and joined the staff as demonstrator in 1889 He published his first paper in 1891, on the Old Red Sandstone of Caithness, a subject pursued again in later years, when he made important discoveries in the Devonian Rocks of southern England and made contributions to the classification of the rocks

In 1891–92 Evans was geologist to an expedition to the Upper Paraguay and other rivers in an almost unknown area in Brazil, later publishing a paper on the geology of Matto Grosso He returned to South America as leader of an expedition to north east Bolivia in 1901-2, and wrote descriptions of the area for the *Geographical Journal*, as well as geological papers

Meanwhile Evans had been appointed geologist to the State of Kathiawar, where he made important collections, afterwards described by himself or his students Then, in 1894, he passed to Mysore, becoming chief geologist and chief inspector of mines, etc In 1901 he received the Lyell award from the Geological Society, and about the same time took the D Sc of the University of London for a thesis on the geology of India

In 1904 Evans became special assistant in geology at the Imperial Institute, serving on the Colonial Survey Committee and Mineral Council of the Institute, posts which not only gave him the opportunity of acquiring a wide knowledge of the mineral resources of the Empire, but also a close interest in the personnel and work of the surveys This interest was enhanced by his appointment, later, as Colonial Office representative on the Imperial Mineral Resources Bureau, and here his legal knowledge was of much use in connexion with the improvement of mining codes in the Dependencies

From this time onward, Evans took much interest in mineralogy and crystallography, publishing papers on projections, classification, and nomenclature, on methods of investigation, and on the properties of certain minerals Much of this work was summed up in his own book on the determination of minerals under the microscope, and in his joint work on crystallography He was treasurer of the Mineralogical Society from 1918 until 1924, and afterwards foreign secretary until his death His teaching work was at the Birkbeck College from 1906 until 1920 and, as lecturer in petrology, at the Imperial College from 1912 until 1927 He was an inspiring teacher, and many of the students beginning research under his supervision have become leading geological surveyors or investigators

Dr Evans was a devoted adherent to the Geologists' Association, often leading excursions or contributing to the proceedings He was president in 1913 14, and dealt in his addresses with the wearing down of the rocks, a subject which his mathematical ability enabled him to treat in a fashion unusual and provocative of new work He was president of Section C (Geology) of the British Association at Bournemouth in 1919

The great War revealed a new side in Dr Evans's character His experience as a volunteer qualified him for a commission, and with the rank of lieut-colonel he was put in charge of a section of the northern defences of London He also served on the tribunal, was made a Justice of the Peace, and received the Volunteer Decoration

After being elected a fellow of the Royal Society, gazetted a C B E, and awarded its Murchison Medal by the Geological Society, Evans served in the presidency of the Geological Society during 1924–1926 Again he broke new ground and devoted his first address to the consideration of areas of tension in the earth crust, and the second to areas of compression About this time he became interested in the Wegener hypothesis, led a discussion on it at the British Association, and revised Skerl's translation of Wegener's book

Although petrology and mineralogy, and especi

ally their fundamental problems of genesis, were the main subjects to which Evans devoted his technical attention, his wide knowledge and critical acumen were constantly in evidence at meetings of many scientific societies, and particularly those dealing with geology and geography His contributions invariably brought up some overlooked fact, some unexpected point of view, or some novel theory or new application or an old principle It was the same with his letters and reviews in NATURE and other scientific journals

Before the War, Evans had got together a team of geologists to write the British volume of " Regionale Geologie ", to which he himself also contributed This was in type before 1914, and was actually published in Heidelberg during the War The copyright passed to England, and a revised edition has been brought out lately under his joint editorship and with the title of " Handbook to the Geology of Great Britain " He retired from the Imperial College in 1927 and took over the chairmanship of the Geophysical Company, for whom he visited the near East Evans rejoiced in every opportunity for travel, and for learning at first hand from the field itself or from the experiences of his colleagues there He was present at the last three International Geological Congresses, and after the last, at Pretoria in 1929, he travelled from the Cape to Cairo, visiting *en route* the various geological surveys, several of them run by his old pupils, inspecting their work, learning their problems, and inspiring them with new ideas Although to a man of his years such a journey was fraught with fatigue and some hardship, there was no suspicion that the end was near Indeed, when he returned to England in the spring of 1930, he travelled abroad again, and had planned a later visit to Palestine and Egypt

It is difficult to do justice to the work and career of so many sided a man, and this is a mere sketch of the chief of his work It may be said that while he left few branches of geology unstudied, he extended knowledge, improved methods, or clarified results in every division of the subject that he touched The simplicity of his character, the lovableness of his nature, his genuine interest and enthusiasm made him hosts of friends , while as for adversaries, if he had any, in the kindness of his heart he never realised their existence

PROF FRITZ PREGL

THE world famous Austrian micro chemist, Dr Fritz Pregl, died of pneumonia, after a very brief illness, on Dec 13 last Prof Pregl, who was sixty-one years of age when he died, was born at Laibach, a town which is now in Jugo Slavia but is less than 100 miles south of Graz, the capital of ' green Styria ', where he lived nearly all his life as student, research assistant, and finally as professor, the head of the Department of Medical Chemistry in the university He studied medicine—which in Austria comprises considerably more pure science than in most English medical schools—and after taking his degree, he chose rather physiological research than the practice of medicine He was appointed an assistant in the Department of Physiology in the University of Graz, and his first work was on the various organic constituents of the intestinal juice of a lamb, and a study of their digestive action, which he published in *Pflüger's Archives* in 1895

Prof Pregl's most important physiological work was on the acids in human and ox bile, of which cholic acid is the chief constituent He studied, so far as possible on a quantitative basis, their preparation, behaviour, and oxidation products, and built up that wonderful technique which was to enable him later to achieve success in more delicate quantitative organic determinations than had hitherto been considered possible

Prof Pregl's own words may be used to describe why he began his micro analytical work " In the summer of the year 1910, in the course of a lengthy investigation of the gallic acids, I obtained an extremely small quantity of a decomposition product I had to make a decision either to continue the investigation with exceptionally large quantities of the original material, or so to refine the quantitative analysis of organic substances that it should be possible to obtain correct analytical figures, from which formulæ could be determined with certainty, with exceptionally small quantities of material " He decided on the second alternative, with such success that by the end of 1911 he had worked out methods for the combustion of carbon and hydrogen, and a Dumas determination of nitrogen on a micro scale Since then he improved his methods and extended them to include all the commoner elements which may be present in organic compounds, as well as the determination of many organic groups The amount of material used in each determination is only a few milligrams, or about a hundred times less than on the ordinary or macro scale, but the same degree of accuracy is attained

As well as great skill in glass blowing—for Prof Pregl designed and made his own glass apparatus—the work necessitated extreme care and attention to detail, and it is interesting that in investigating the possible sources of error he was able to throw light on many hitherto unexplained errors obtainable on the macro scale In recognition of his services to science, Prof Pregl was awarded the Nobel prize for chemistry for 1923 The methods are described in his book, " Quantitative Organic Micro Analysis ", first published in 1917 , the third edition, completely revised, was published in the year of his death The book is written in a style as careful and accomplished as is his laboratory technique Prof Pregl, however, believed rather in the old tradition of learning by personal tuition than from practical manuals, and the hospitality of his laboratories has always been given to scientific workers from all over the world who wished to learn his methods In this way no less than three hundred chemists and biologists have learned his technique, and on returning to their own laboratories have developed and applied his methods to all branches of chemistry where economy of time or

material is of importance All who had the privilege of knowing him personally will remember him not only as a great scientific worker, but also as a charming man and a gifted talker, with an enthusiasm for his work that was contagious

The great importance of Prof Pregl's influence is that he stressed the fact that careful, accurate technique is the basis of all good scientific work, while his methods have made accuracy possible in realms where previously there were only rough approximations

DR HENRY M AMI

DR HENRY MARK AMI, who died at Menton, southern France, on Jan 4, aged seventy two years, was a well known geologist who had made valuable contributions to our knowledge of the Palæozoic rocks and fossils of Canada He was born in Geneva, the son of a Swiss Protestant clergyman who emigrated to Canada when he was a child He was at school in Ottawa, and thence proceeded to McGill University, where he had a distinguished career and came under the influence of the eminent Canadian geologist, Sir J William Dawson, who was at that time Principal of the University He graduated as M A and D Sc in 1882, and in the same year he joined the staff of the Geological Survey of Canada, from which he retired in 1912

During his official life, Dr Ami devoted special attention to the Palæozoic fossils of eastern Canada in the Survey Museum in Ottawa, and added greatly to the value of his researches by studying all the localities whence the fossils were obtained He also made frequent visits to Europe, especially to England and France, to compare the corresponding geological formations on the two margins of the Atlantic Ocean He was thus able to throw much new light on disputed questions as to the precise age and succession of the various rocks His researches on the Devonian and Carboniferous formations of Nova Scotia were particularly noteworthy

While occupied with his technical work, Dr Ami travelled extensively and took a deep interest in everything Canadian He was thus well equipped on his retirement from official duties to undertake the revision and partial rewriting of the volume on Canada and Newfoundland in Stanford's 'Compendium of Geography", which was published in 1915 During the War he did good service to the Government in advising on the source of metallic minerals, and was for some time connected with the Trade Department of the British Embassy at Washington During more recent years he was much handicapped by failing health, but from 1922 onwards he paid an annual visit to the Dordogne, France, where he directed the Canadian School of Prehistory, which he founded He took part personally in the diggings, which furnished fine collections of Palæolithic flint implements to many of the chief museums in Canada

Dr Ami was a familiar figure at scientific congresses, and his genial good nature won him a host of devoted friends on both sides of the Atlantic He was a fellow of the Royal Society of Canada and of the Geological and Royal Geographical Societies of London, and was awarded the Bigsby Medal of the Geological Society in 1903 A S W

MR W D CHRISTMAS

WILLIAM DURANT CHRISTMAS died at Peppard, Oxon, on Jan 3, at the age of sixty years Educated at Ellesmere College, Shropshire, he was at first a teacher, holding appointments at Haverford west and Rugeley His natural bent for figures found an outlet later when he joined a Stock Exchange firm During the War he joined the staff of the Rothamsted Experimental Station in a voluntary capacity, at a time when difficulties were being experienced in getting the work done owing to the absence of members of the staff on War service He assisted in keeping the records, and was particularly attracted to meteorology

After the War considerable expansion took place in the Rothamsted Experimental Station, and a Statistical Department was set up, Mr Christmas continued until his death as an honorary worker on the staff of this Department Aided by W C Game and A D Dunkley, of the regular staff, he undertook the compilation of the monthly weather records with great enthusiasm and abundant energy In letters to NATURE of Nov 3, 1921, and Jan 26, 1922, he directed attention to the abnormal conditions of the year through which we had been passing, a year which will be remembered for its record low rainfall He followed this up by contributing to the *Times* of Jan 26, 1923, a summary of the rainfall in 1922 This was the beginning of a regular series of letters which appeared in the columns of the *Times* at frequent intervals until the issue of Nov 3, 1930, when his last letter was published Besides rainfall, he dealt with percolation, sunshine, temperature, and related meteorological phenomena, such as fogs and storms

Mr Christmas had been in failing health for some years, and never recovered from the blow occasioned by his wife's death in 1929 But he kept up his Rothamsted work until his last illness, and it was a matter of deep regret to him that he was unable to contribute his customary summary of the year's weather to the *Times* on Jan 2, but had to entrust the task to another

WE regret to announce the following deaths

Prof S Henschen, professor of internal medicine at the Caroline Medical Chirurgical Institute, Stockholm, who carried out much research in anatomy and the pathology of the nervous system, aged eighty three years

Prof C von Monakow, of Zurich, one of the founders of modern neurology and author of "Die Lokalisation im Grosshirn", aged seventy-seven years

Prof J Ricard (S J), who was professor of mathematics and later director of the observatory of the University of Santa Clara, aged eighty years

Dr I Urban, assistant director of the Botanical Museum, Berlin, on Jan 7, aged eighty two years

News and Views.

PROF JOHN MACLEAN, of Wilson College, Bombay, writes in dissent from our article, "Administration and Research in India" (NATURE, Nov 22, 1930 p 797), to point out the danger of certain views on the Indian question current in England, among which he includes those we have expressed He maintains that Western education in India should not be criticised without allowance for misdirected effort, poverty of resources, and subservience to tradition Further, that no one thinks that self government will lead to peace and absence of friction nine months ago a fundamental change took place in India which has astonished the Indians themselves The Indian now claims to be regarded as a self respecting fellow man This has aroused the Indian woman Any assumption of superiority on the part of the Englishman, such as is now to be observed in London, will lead to ineradicable bitterness He asserts that gradual progress is not enough and that there is sufficient good will in India to warrant a leap in the dark He adds that the poll of the *Times of India* has shown that four out of five of the non official Europeans in Bombay are in favour of Dominion status Prof Maclean's criticism of our views trenches upon political arguments with which it would be out of place to deal here We may, however, point out in passing that the grant of a form of self government which admittedly will not lead to peace is perhaps a questionable improvement upon the *status quo*, but the fundamental change in India to which he alludes has not escaped attention in England He confirms the view that the situation is far more critical than is generally realised Be that as it may, these arguments do not affect our main contention The question of superiority does not arise it is difference of culture that counts In the future, even more than in the past, a satisfactory solution of Indian problems of government must be sought through the application of the results of scientific study of race and culture

THE truth of the matter is that the divergence of opposing views on the Indian question is so great as to make it difficult to find a common denominator which will afford a basis of discussion Prof Maclean sends us a report of an address on "Gandhi Politician and World Teacher", by Prof A Wadhia, as president of the Indian Philosophical Congress, in which he extols Gandhi as one of the world's great philosophers, a thinker who has transcended, or transformed, Hinduism and attained universality When Prof Wadhia turns to Gandhi's work as a political thinker and practical politician, the only concrete proposal is "Hind Swaraj" For Gandhi, Indian Home Rule is 'the ideal state' It must be remembered that Gandhi's philosophy is no mere intellectual system, but a 'way of life' It is the practical means of attainment, which, barely and baldly stated, have an element of bathos, that have laid him open to the charge of narrowness, casuistry, insincerity, and worse Even admitting the universality of Gandhi's philosophy—assuredly no product of intellectual or cultural inferiority—this is no warrant for allowing claims that would hand over control of the destinies of many millions to a comparatively small section, however much these claims may receive the doubtful support of pseudo scientific theory which seeks to show that India is virtually one in culture and race It may be that the trend of development in India is along the lines of Hinduism, but there are many who are and always will be outside those lines As we have already pointed out in these columns, an accurate knowledge and exhaustive study of the facts is required Only then can the claims of caste, outcaste, and depressed receive fair and equal treatment

ON Jan 14 the freedom of the Borough of Bangor was conferred on Dr Griffith Evans, who, fifty years ago, was inspecting veterinary surgeon to the Government of Madras In then discovering the first pathogenic trypanosome he laid bare the cause of a disease which was causing havoc amongst the camels and horses of the Punjab Frontier Force Although the senior medical officers in India were definitely opposed to the theory of pathogenesis advocated by Dr Evans, the younger men have followed with success the lines of investigation he indicated He thus opened a campaign, which still continues, against what is now recognised as one of the most destructive groups of disease producing organisms with which science has to contend Tetanus was another field in which Dr Evans showed his power of original thought At Ipswich in 1870 there was a bad outbreak of the disease, in which every case had proved fatal Being invited to a consultation, he gave his view that the disease was a specific fever for which there was no known specific remedy Arguing from his experience of the disease in horses, he urged that the treatment should be rest in a dark, silent room, no noise from without or within, no food of any kind nor any medicine, but let the patient drink water *ad lib*, and leave the rest to Nature Accepting responsibility for the treatment of the case of a child, he had the full courage of his convictions, and the case recovered At the age of ninety six years, Dr Evans still retains his mental activity

LITTLE direct news has come through of the earthquake that was so destructive in the south of Mexico on Jan 14 That it was a great earthquake is shown by the record at Kew The first movements reached that observatory at 2 h 2 m 59 s A M on Jan 15, and the earthquake that gave rise to them must have occurred in Mexico at about 9 P M local time on the previous evening The earthquake is said to have been the most violent experienced in the country since 1911 The epicentre was probably close to the City of Oaxaca, which has been almost completely destroyed, with the loss of at least 40 lives The extent of the disaster may, however, remain for some time unknown, owing to the wide interruption of communications How great it was is clear from the fact that there was also considerable damage in the City of Mexico, 230 miles from Oaxaca In the south of the country, there are numerous well defined earth-

quake centres, one of the most important of which lies in the district round Oaxaca That city suffered twice from earthquakes in 1928, on June 16 and Oct 9 (NATURE, vol 121, p 994, and vol 122, pp 68, 620), but the epicentres then were both submarine, at some distance from land On Jan 2 (*Daily Science News Bulletin*), a strong submarine earthquake occurred with its centre in lat 17 8° N, long 108° W, several hundred miles to the west of those in 1928

ANOTHER step forward has been taken in making navigation safer during a thick fog We learn from the *Times* of Jan 13 that the Clyde lighthouse trustees have put a talking beacon in the Cumbrae lighthouse, and that instructions have been given to mariners regarding its use It is the first device of the kind in the world It consists merely of a radio gramophone used in conjunction with the lighthouse foghorn By this means the radio operator on the ship is told exactly how far his ship is from the lighthouse The record played on the lighthouse gramophone is simply the name of the beacon in speech (Cumbrae) repeated every 70 seconds, and numbers counted in miles and cables up to five miles These signals are transmitted by radio There is then an interval of silence of 27 seconds until the name Cumbrae is heard again and the counting recommences The signals of the foghorn are heard directly The difference in the times of hearing the word Cumbrae and the foghorn is practically equal to the time taken by sound to travel this distance, and so the gramophone numbers give the distance Actual tests have been carried out on this device by ships of the Anchor line and were found quite satisfactory The 'talking beacon' was invented by C A and D A Stevenson, of Edinburgh, the connexion of whose family with lighthouses is well known to every reader of R L Stevenson When vessels are equipped with this device, which is quite cheap to install, they will have a good idea of their distance from other ships, thus avoiding one of the causes of collision at sea While the apparatus is still in its infancy, the trustees have warned mariners to take, in addition, the usual precautions during fog

NEARLY all the peculiar phenomena which are experienced in radio transmission can be explained by supposing that the radio signals travel from one station to another by more than one route The direct line of transmission is usually one of these paths Very often the greater part of the signal which we hear has travelled to the upper regions and back, and constitutes what is called a wireless echo In the *Wireless World* for Jan 7 and 14 Prof E V Appleton gives an interesting paper on the timing of wireless echoes, and suggests alternative theories of the Kennelly Heaviside layer The time taken to traverse the different paths is known definitely, and guesses are made as to what these paths are The first experiments on the timing of the journeys of radio waves were carried out almost simultaneously in Great Britain and the United States It was assumed that there was a conducting layer, and the English experiments placed its height as about 100 km On the other hand, the American experiments indicated a height of about 220 km Whilst the wave length used by the English physicists was 400 metres, that used by the Americans was 75 metres On repeating the English experiments with wavelengths of 75 metres, it was found that the height deduced for the conducting layer was the same as that found by the Americans There was a certain critical wave length at which the echo time suddenly doubled There is therefore definite evidence that there are two reflecting layers at different heights, the lower sending back the long waves and the upper sending back the short waves In the second part of his paper Prof Appleton discusses the effects that these short period echoes will have in radio picture-telegraphy and in radio television

IN a paper on "Recent Developments in Telephony", read by Dr E H Colpitts at the Cleveland meeting of the American Association for the Advancement of Science, a summary of which appeared in the *Daily Science News Bulletin* for Dec 30, it was stated that the plans for a Hawaii California telephone circuit are now well under way Hawaii is very centrally situated, as it is roughly equidistant from North and South America, Asia, and Australia A short wave station will be established to communicate with Honolulu, and another radio link from a point on the Atlantic coast to Bermuda is also planned Radio stations of limited range are being established at several of the principal ports They are equipped so that communication with ships at sea can easily be made This extends the service given by liners like the *Leviathan*, which, at present, is in telephone communication with the shore all the way across the Atlantic Although radio has made huge advances of recent years, it is still not so trustworthy as a submarine cable A trans Atlantic telephone cable is now being prepared When completed it will be connected with about 2000 miles of land cable in Europe It will thus be possible from Hawaii to talk over about 7000 miles of wire Surprise was expressed that no mention was made of the work done by the Bell Telephone laboratories on television, as recently two way television was shown to be possible in New York This is interpreted as meaning that the commercial application of television is still in the distant future

ONE of the earliest writers on marine engineering spoke of the boiler as "the source and magazine of all our power", while another referred to it as "the fountain head from which all benefit is derived" These remarks were made when the ordinary steam pressure at sea was but 5 lb per sq in, but they apply equally well to day when pressures have risen to 400 lb and 500 lb Recent progress in marine boilers is among the subjects dealt with in the *Engineer* for Jan 9, in which are given illustrations of the latest designs of the well known Yarrow and Babcock and Wilcox boilers for high pressures and temperatures Another boiler is that recently designed by J Johnson, the superintendent engineer of the Canadian Pacific Steamships, Ltd In some ways the Johnson boiler is a new departure, there being only two drums, an upper and a lower one, and these are joined by

tubes bent to crescent form bulging out either side of the centre line of the boiler. Other tubes run vertically between the drums, and still more tubes form water walls at the end of the boiler. The furnace spaces are thus practically enclosed by walls of water tubes. Tried first in the *Princess Helene*, another boiler has been built for the *Empress of Britain*, and a test of this 10,000 h.p. boiler showed that at mercantile ratings and for the same efficiency it will yield, for the same weight of boiler and air heater, double the output of the three-drum water tube boiler. One feature of the boiler is the use of air for combustion preheated to 500° F.

IMPORTANT statistics regarding the production of rubber were given in a paper read on Jan. 13 by Dr. G. Rae, at Birmingham, to the Midland Section of the Institution of the Rubber Industry. The total area under plantation rubber at the end of 1929, he said, was between 6,600,000 acres and 7,200,000 acres, of which the area under native rubber in the Dutch East Indies was variously estimated at between 1,100,000 acres and 1,700,000. About 3,360,000 acres were in estates owned by Europeans and Americans; 510,000 acres in Asiatic owned estates of more than 100 acres, and 1,630,000 acres in native holdings of less than 100 acres. The total exports of rubber from producing countries were 94,000 tons in 1910; 354,000 tons in 1920; 518,000 tons in 1925, and 861,000 tons in 1929. The output for 1930 was 820,000 tons. Of the output in 1929, British producers were responsible for 36 per cent, Dutch and other European producers 10.2 per cent, and American producers 2.6 per cent. The absorption of rubber by manufacturers (that is, the quantities of rubber they turned into rubber goods) was 85,000 tons in 1910; 310,000 tons in 1920; 560,000 tons in 1925; 790,000 tons in 1929, but would be approximately only 705,000 tons in 1930.

THE United States Department of Agriculture has published a booklet, written by Prof. A. J. Henry, Principal Meteorologist, Weather Bureau, entitled "Weather Forecasting from Synoptic Charts", which deals primarily with American methods of weather prediction. These are described in considerable detail. They are of interest in showing, among other points, the specialised methods that have been developed for dealing with the requirements of particular sections of the agricultural community, and the arrangements for issuing storm warnings. There is no other country that has to deal with such violent fluctuations of temperature in a short time and with such possibilities of financial loss involved in consequence of them, and that has also to take into account possibilities of locally destructive tornadoes and of tropical revolving storms that may cause the loss of thousands of lives, in addition to gales arising as a result of the eccentricities of an exceptionally lively portion of the storm belt of middle to high latitudes, where anticyclones have the peculiar characteristic of a mean rate of travel approximately equal to that of depressions. It is not surprising to find that an unusually extensive development of the system of local forecasting has taken place, and that it has apparently met with great success. This system involves the delegation of forecasting for single States, and even in some instances for parts of one State, to forecasters resident within the area allotted to them having authority to amplify or modify the deductions about future weather made at the central bureau in Washington. Such forecasters construct their own synoptic weather maps, and doubtless employ a closer network of stations than can be dealt with at the central bureau, gaining thereby a special knowledge of local conditions. The booklet is intended primarily for home use. It is, however, an important addition to European meteorological libraries and deserves careful study on this side of the Atlantic when the creation of new meteorological services or the enlargement of existing ones is under consideration.

IN the *Časopis Společnosti Přatel Starožitnosti Československých* Dr. O. Odložilík has traced a letter written by the medieval pedagogue, Jan Amos Komenský (Comenius), dated Mar. 4/14, 1647, relating to the exile of himself and the engraver, Vaclav Hollar. Komenský expresses his regret that circumstances forced them to leave home through the religious persecution of the counter-reformation. Dr. Odložilík comments upon the work and influence of these Czech scholars on contemporary thought. Komenský conceived the idea of making a survey of all human knowledge, which was even then becoming more and more extensive owing to the development of the natural sciences. He began the compilation of a kind of encyclopædia where knowledge was to be arranged under twenty-eight sections. Only a fragment of this work remains. He attempted a definition of the most intrinsic and general features common to all created things thinking that if this could once be achieved it would be easy for him to indicate the way to a knowledge of details. Knowledge might be infinitely differentiated and divergent so long as a common foundation could be established, such as would assure a steady progress in science. These ideas of Komenský were first outlined in a work which appeared in Oxford in 1637 under the title "Conatuum Comenianorum Præludia". Although his views impressed and influenced those English men of science who later were instrumental in founding the Royal Society, Komenský's pan-sophic schemes and educational programmes could scarcely succeed during his lifetime. There was civil war in England and the Thirty Years' War was devastating Europe. Nevertheless much of his teaching has since borne fruit.

THE fifth volume of the annual summary of scientific and economic research work in agriculture, entitled "Agricultural Research in 1929", has been published by the Royal Agricultural Society of England (price 1s. 3d. post free). This publication has now established for itself a definite place in the periodical literature of the farming industry, and should be studied by all those wishing to keep themselves abreast of modern agricultural practice. The various branches of agriculture are considered under seven main headings as in previous years. The information covers such a wide field that it is impossible to do more than indicate some

of the many interesting and important subjects considered. The recently developed tar distillate sprays for fruit trees are discussed in some detail, and it is evident that as winter washes they are extremely effective against many insect pests. For the arable farmer, the articles on varieties of sugar beet, and the control of rust and smut diseases of cereals, in which practical methods with relative costs are included, will be of particular value. As regards dairy husbandry, fundamental problems such as breeding and management of cattle, milking methods, and the interpretation and use of milk records are considered. For those interested in engineering questions, articles on the use of electricity, traction, and the development of some of the newer farm implements are included. Feeding values for dairy cows and pigs are the chief subjects on animal nutrition discussed, the importance of minerals in stock feeding being emphasised, and it is evident from the section on veterinary science that considerable advances have been made in the control of contagious abortion and tuberculosis. Under the heading of soils and fertilisers, soil classification and methods of land reclamation are discussed, and data as to the world production and consumption of the chief fertilisers are given, the use of nitrogen and potash in particular showing a large increase. Each section concludes with a list of papers quoted.

"THE Mechanism of Organic Evolution" was the subject of an address by Charles B. Davenport, to the Washington Academy of Sciences, which appears in the *Journal* of the Academy (vol. 20, p. 317, 1930). After revising some of the recent observations on the occurrence of mutations, their direction, and their natural selection, he summarises the mechanism of organic evolution as consisting of a series of processes: infinite capacity of the germinal material for reproduction; infinite capacity for mutation; an infinitude of different kinds of environments; extensive opportunities for dissemination of the mutant individuals over the earth, permitting some of them to find an environment for which they are specially fitted; as for the rest of the infinitude of individuals, non-mutant and mutant (beyond the number required for replacement), elimination. The organic world is far from being the infinitely diverse collection of haphazard and meaningless variants to be expected if mutations were uncontrolled. The directive influence, according to the author, appears to work through the repeated losses of something from the parental gene. This may be true of the cases Davenport selects, albinism, hairlessness, and the like, but our difficulty is to see how, looking broadly at the products of evolution, loss in the gene can mean greater complexity in the final product—in short, how the organic progress from amœba to man can be due to successive losses in the germinal content.

ONE of the most significant of the articles in the September-October number of *Natural History*, the journal of the American Museum of Natural History, discusses "The Museum in Education". The sub-title contains the challenge and gist of the argument: "the unparalleled present-day opportunity [of museums] to serve the community and to participate in the rapidly advancing movement for visual instruction". The way in which the American Museum of Natural History takes its share in this movement sets an example to be emulated. We need simply enumerate the museum educational activities to show their thoroughness and diversity. The extra-mural activities of museum service in the schools and colleges include circulation of nature study collections, lending of lantern slides, distribution of motion picture films, lectures in schools, lending of circulating collections to branch libraries, co-operation with nature rooms in schools, and the Trailside Museum and Nature Trails at Bear Mountain. The intramural activities of school service at the museum comprise lecture courses in the museum, instruction for the blind, exhibition hall instruction and guidance for visiting groups, the Junior Astronomy Club, special courses for teachers, adult education, and co-operation with the training schools for teachers, high schools, and colleges.

A RECENT issue of the scientific journal *Physis* (vol. 10, No. 35), the publication of the Natural History Society of Argentina, contains a series of valuable papers on the structures of mammalia. Two papers discuss the fossil mammals of various parts of South America. From the pampean fauna of Patagonia, Lorenzo J. Parodi describes several interesting relics, including a new species of *Megatherium* of which a fine skull has been discovered, a portion of a carapace of *Glyptodon*, and phalanges of *Mylodon*. From the Friaseana beds of mid and lower Miocene, Lucas Kraglievich describes an extensive fauna, containing many new species of mammals, which he regards as a transitional association connecting the definite faunas of Santa Cruz on one hand and of Entre Rios, Catamarca, and Monte Hermoso on the other. An aspect of the evolution of the present day mammalian fauna is dealt with by the same author in a useful paper on the craniometry and classification of South American wild dogs, in which he refers specially to the recent and fossil forms found in the Argentine. Finally, Rodolfo Parodi makes a contribution to the osteology of the larger living felines of the Argentine, the puma, the jaguar, and the ocelot.

WE have referred previously to Research Narratives published by Engineering Foundation, Inc., 29 West 39th Street, New York, which have been published in book form. By the courtesy of the Director, Mr. A. D. Flinn, we have now received copies of some further Narratives as they are first published, month by month, in leaflet form. Many leaders in finance, industry, engineering, and education, we are told, have these sent to them regularly in this convenient form, the leaflets being of such a size as can be slipped into a pocket book or wallet so that they can be read at a convenient moment. Of those issued last year, that for April was on isotopes; that for June, on pressure and matter; that for August, on short-wave high power radio tubes; while that for September contained an interesting account of the ingenious method adopted for damming the Saguenay River about 140 miles

north of the city of Quebec, where a mass of concrete, 92 ft high and about 45 ft square in section, was built upright on the bank of the river and then allowed to fall across the stream

THE centenary of the birth of James Clerk Maxwell is to be celebrated in the University of Cambridge on Oct 1 and 2, following on the Faraday celebration and the centenary meeting of the British Association in London Addresses are to be given at Cambridge by Profs Einstein, Langevin, Larmor, Planck, Sir James Jeans, and Sir J J Thomson

MR W A MACFADYEN, Longships, Capel le Ferne, Folkestone, has written objecting to the spelling in the letter by Dr C Crossland in NATURE of Dec 27, p 991, of the place Ghardáqa He urges that since the Anglo Egyptian Oilfields, Ltd, drilled the first oil well there in 1914, the spelling Hurghada has been used, and this form is also used officially by the Egyptian Government for the post and telegraph services It would appear, however, that the name is correctly Ghardaqa, pronounced locally with the regular accentuation on the first syllable, writing from Cairo, Dr Crossland would put the accent on the second syllable The form Hurghada is supposed to be easier for Europeans to pronounce, but it is incorrect and phonetically distasteful to Arabic scholars

MR JAMES DRUMMOND, of Christchurch, New Zealand, who, at the age of sixty-one years, has retired from ordinary practical journalism, for a long time has successfully combined work on a daily newspaper with natural history Interested in the botany, zoology, and geology of his own country, and realising that in the newspaper Press he had a unique means of passing knowledge on to the public, he seriously and earnestly took in hand an educational work in this direction Every week for twenty five years he has published a popular natural history article in a syndicate of leading New Zealand journals, with very gratifying results, evidenced by many expressions of appreciation He has also published a number of books on New Zealand natural history, of which the most important, "The Animals of New Zealand", was written in collaboration with the late Capt F W Hutton and is in its fourth edition Mr Drummond has published books on other subjects, but now intends to devote his literary activities to the natural history of New Zealand

THE annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers on Mar 11 and 12 under the presidency of Dr R Seligman, the programme includes fourteen papers on various aspects of non ferrous metallurgy It is also announced that the May lecture of the Institute will be delivered on May 6 by Mr W B Woodhouse, of the Yorkshire Electric Power Company, who will deal with the technical and economic progress in large scale electric power generation The annual autumn meeting of the Institute will be held in Zurich on Sept 13 16, immediately following the meeting of the International Association for Testing Materials

THE Council of the Geological Society has this year made the following awards Wollaston Medal to Dr A W Rogers, of the Geological Survey of the Union of South Africa, in recognition of the value of his work on the geology of South Africa Murchison Medal to Dr G W Tyrell, of the University of Glasgow, for his work on the igneous rocks of the west of Scotland Lyell Medal to Mr E C Andrews, of the Geological Survey of New South Wales, for his researches on the economic geology of New South Wales and on physical geology Bigsby Medal to Dr Norman L Bowen, of the Geological Laboratory, Carnegie Institution, Washington, D C, in recognition of the value of his researches on the physical chemistry of igneous rocks Wollaston Fund to Dr R G S Hudson, for his work on the stratigraphy and palæontology of the Carboniferous rocks of Yorkshire Murchison Fund to Dr C J Stubblefield, for his researches on the Cambrian rocks of Shropshire and on invertebrate palæontology A moiety of the Lyell Fund to Dr O M B Bulman, in recognition of his work on the Cambrian rocks of Shropshire and of his palæontological researches, and a second moiety of the Lyell Fund to Mr W H Wilcockson, for his work on petrology and economic geology

WE have received from Science Service, Washington, a brief account of the demonstration by Dr George W Crile, at the recent meeting of the American Association for the Advancement of Science in Cleveland, of what he calls "autosynthetic cells" Dr Crile brought together certain proteins, lipoidal brain extracts, and mineral salts in small cavities on glass slides, and in a few seconds the materials arrange themselves into masses showing certain resemblances to various types of unicellular organism Among these resemblances are cited nucleation, growth and division by fission and budding, respiration, stainability, motility, and electric charge, they disintegrate when the difference of potential between 'cytoplasm' and 'nucleus' reaches zero The addition of narcotics and anæsthetics causes a decrease in potential and in respiration, which are reduced to zero under the influence of cyanides and toxins These structures have been kept in 'life' for ten weeks by the repeated addition of protein to the 'culture' The experiments, so far as reported, suggest that certain mixtures of colloidal and other substances may be induced to arrange themselves into structures exhibiting some of the properties, both morphological and physiological, of living cells Various experiments with irradiated proteins and lipoids, and with these substances derived from cancer cells, are also mentioned

THAT chlorophyll and hæmaglobin are analogous organic compounds, which can be reduced to the same type of pyrrole derivative by removal of the metal—magnesium in the case of chlorophyll, iron in the case of hæmaglobin—and further treatment, has been well known since the classic researches of Willstätter upon chlorophyll It is very interesting to learn, therefore, that liver extract, successfully used to check the course of pernicious anæmia in human beings, has now been used by Prof O Raber to check the yellowing of given plants grown under etiolation conditions Prof Raber's experiments were reported to the

American Society of Plant Physiologists meeting in Cleveland, U S A, according to a report received through Science Service, of Washington, D C

YEAR BOOK No 28 of the Carnegie Institution of Washington contains a series of brief but interesting "Reports on Investigations" from the Department of Embryology under the directorship of Dr Streeter It is not possible to mention all the reports, covering as they do such a wide field, from more or less straight forward embryology to experimental work, pathology, and tissue culture Certain reports, however, seem of wide interest Drs Gregory and Lewis have succeeded in making a kinematograph record of the developing rabbit's ovum from the first cleavage up to the formation of the cleavage cavity Dr Hartman has worked out the rate of intra uterine and post-natal development of the opossum in considerable detail, and alone and in co operation with colleagues added much to our knowledge of the phenomena associated with reproduction in *Macacus rhesus* Dr Hines has produced a monographic study of the brain of *Ornithorhynchus*

APPLICATIONS are invited for the following appointments, on or before the dates mentioned — A science master and a master for engineering subjects (mechanics, machine drawing, and engineering science) in the Junior Technical School for Boys of the North Western Polytechnic—The Secretary, North Western Polytechnic, Prince of Wales Road, N W 5 (Jan 30) A laboratory assistant at the L C C Shoreditch Technical Institution—The Education Officer (T 1), The County Hall, S E 1 (Jan 31) An assistant radiologist at the Hospital for Tropical Diseases, Endsleigh Gardens — The Secretary, Seamen's Hospital Society, Greenwich (Feb 4) A professor of educational psychology in the Egyptian Institute of Education — The Director, Egyptian Education Office, 30 Victoria Street, S W 1 (Feb 9) A director of the Gardens of the Royal Horticultural Society, Wisley—The President, Royal Horticultural Society, Vincent Square, S W 1 (Mar 2) A professor of zoology in the Queen's University of Belfast—The Secretary, Queen's University, Belfast (April 30) A lecturer in agriculture in the University of Reading —The Registrar, The University, Reading An assistant lecturer in mathematics and demonstrator in physics or chemistry at Faraday House Electrical Engineering College—Dr A Russell, Faraday House, Southampton Row, W C 1

Our Astronomical Column.

Eros —Prof Hartmann makes a bold suggestion in *Astr Nach*, 5762, to explain the twofold fact that Eros deviates considerably from the predicted ephemeris, and that it is about a magnitude fainter than was expected He notes that even before the present apparition the peculiar curve of light variation had caused the suggestion to be made that the planet was shaped like a dumb bell He now suggests that Eros has broken into two portions, of which the one now under observation is the fainter If anything of the nature of an explosion accompanied the separation, the two portions would drift apart, thus explaining the error of the ephemeris The suggestion is ingenious, but there are two grave objections

(1) If the fragment under observation is the smaller one, the other would be closer to the predicted place, and could not well have escaped detection on the numerous plates that have been taken

(2) The splitting in two could scarcely leave the rotation period unaffected The light curve now obtained agrees, both in period and type, with the observations made in 1901, which is against any notable change having taken place since then

Planetary Nebulæ and *O* type Stars —A note in the Astronomical Column of NATURE of Feb 1, 1930, p 180, referred to an article by Prof C D Perrine in *Astr Nach*, 5672, on the radial motions of the *O* type stars The note suggested that there was some difficulty in reconciling the two suggestions of Prof Perrine (1) that planetary nebulæ are the relics of former novæ, (2) that planetary nebulæ and the *O* and *B* type stars form a progressive series of objects The idea in the reviewer's mind was the distinction between the catastrophic development of novæ and the apparently steady condition of the *O* and the *B* stars In a letter to the Editor, Prof Perrine now suggests that we have little guarantee of the permanence of spectral types he says, "even to day stars other than novæ are under suspicion of having changed type appreciably" Further, he notes that the spectra of novæ pass in succession through various spectral types, and that a nova the development of which was unusually slow might be classified as a normal *B* type star while it was passing through this stage Prof Perrine further notes, in amplification of his former paper, that he has now applied the radial motion due to galactic rotation, as given by Plaskett's observations, to his results for the *O* type stars "These are made more consistent, strengthening the assumption of a systematic difference between the absorption and emission stars"

Sydney Astrographic Catalogue —The Sydney Observatory is making great efforts to catch up its serious arrears in publishing its section of the astrographic catalogue, which extends from 51° to 65° S Decl It will be published in 52 sections, each covering 6 hours in R A and 2° in Decl, each region of the zone appearing on two plates at least Volumes 11 and 12 have recently been issued, they include the plates the centres of which lie in Decl 54° S, and R A from 12^h to 18^h, and 18^h to 24^h respectively Vol 11 contains 86 pages, and Vol 12 43 pages, a full page contains 280 stars, but many of the pages have blank spaces The lower galactic latitude in the region of Vol 11 explains its greater star density The following volumes of the Sydney catalogue have now been published 1 to 8, 11 and 12

The method of denoting magnitude has not been uniform in these volumes the earlier ones use a scale of letters, the later ones substitute the numbers, 1, 2, 3, etc, for the letters *a*, *b*, *c*, etc The magnitude column is headed "Diameter", which is rather misleading, as numeral 1 denotes the brightest stars, of magnitude about 8 0, and therefore the largest diameters, while 10 denotes those that are just perceptible, magnitude about 12 2 For stars brighter than mag 8 the actual diameter, in thousandths of a reseau interval, is given The dates of exposure of the plates are mainly between 1892 and 1900, but a few are so late as 1925 The *X* and *Y* co ordinates are given to the third decimal of a reseau interval It is noted that up to the year 1912 the plates were measured at Melbourne, but since that date, at Sydney.

Research Items.

The Bundle of Life.—In *Ancient Egypt*, 1930, pt. 3, Miss M. A. Murray brings forward evidence from ancient Egypt in support of Sir James Frazer's contention that the expression 'bundle of life' used by Abigail when addressing David is a reference to the doctrine of the external soul. As the well-being of the whole country depended upon the life and soul of the Pharaoh, every effort was made to protect them from accident or illness. The royal soul would be completely safe if wrapped up and entrusted to the safe keeping of a special official whose life terminated with the life of the king. The object so wrapped up and guarded might well be known as the 'bundle of life.' The placenta and umbilical cord are peculiarly important to primitive minds, and it seems that among certain peoples the placenta or the cord was regarded as the seat of the external soul. It has been pointed out that a certain standard carried before the Pharaoh on ceremonial occasions represented the royal placenta. The beliefs and practices of the Baganda in regard to the royal umbilical cord appear to afford close parallels to Egyptian ritual of the early historical period. In the early period of Egypt the actual object was represented; but later it became highly conventionalised, because the artist was accustomed to see the object in wrappings only. In Uganda the object was entrusted to a high official, ranking next to the Prime Minister; in Egypt it was entrusted to the Prime Minister himself, who was also the chief magician. The rare title in Egypt for which the translation "the Opener of the Placenta" is suggested, would then refer to the death of the king by the opening of the 'bundle of life' to release the soul. This officer would then be the executioner of the king when his divine powers began to wane. The custom was still remembered in the sixth dynasty, though a victim had then been substituted for the royal sacrifice. The title became extinct at the end of the Old Kingdom, but in the New Kingdom the object reappears in temple wall sculptures, plaques, etc.

Chiefs and Shamans in California.—Mr. A. H. Gayton has made a study of the functions of chiefs and shamans respectively in the social organisation of the Yokut and Western Mono of the San Joaquin Valley of southern central California, which is published as No. 8 of vol. 24 of the *University of California Publications in American Archæology and Ethnology*. The political organisations of Yokut and Mono were as simple as any among Californian tribes. They had no clans, and the moiety regulated marriage and participation in ceremonial observance. Patrilineal families dwelt in permanent villages; but they owned no land other than an ill-defined tribal area. They lived by hunting, fishing, and food gathering. Truthfulness, industry, and generosity were not so much virtues as necessities. Legal authority was wielded by the chief, with the winatums as executive officers and go-betweens from the authority of the chief to the people. The chief made decisions on tribal and inter-family affairs, such as fandangoes and mourning ceremonies, the building of a sweat-house and so forth. He gave permission for the infliction of the death penalty. There was a complete absence of formulated law; each case was taken on its merits by the chief, who gave his decision without reference to precedent. Peace and public satisfaction were secured by a power which had no legal basis—the fear of sorcery. The peace of the community depended upon the character of each individual, and this was moulded by the fear of supernatural powers, which could be brought into operation by the individual himself or by a shaman hired for the purpose. Such transgressions as cheating in gambling, adultery, or neglect of any ceremonial duty, by these means would be visited on the offender or a member of his family. The shaman through whom the penalty for transgression was inflicted was not an official. Nevertheless he acted in co-operation with the chief, who utilised his services in punishing an individual who did not take his part in carrying out any public duty, such as contributing his fair share to a fandango, mourning ceremony, or the like. A check was kept on both the shaman and the chief by the fact that oppression or unfairness on the part of the chief, or trickery or abuse of his function by the shaman, would be punished by exposure, loss of influence and position, and even death.

Leonardo da Vinci as Anatomist.—In his recent excellent monograph entitled "Leonardo da Vinci the Anatomist (1452–1519)" (Publication No. 411 of the Carnegie Institution of Washington. Baltimore, Md.: Williams and Wilkins Co. 6 dollars), Dr. J. Playfair McMurrich, professor of anatomy of the University of Toronto, has given an impartial account of Leonardo's achievements as an anatomist and of his status in the history of anatomy. Dr. McMurrich points out that, though Leonardo was greatly influenced by the Arabists, particularly as regards his nomenclature and physiology, he merits the title of great anatomist as well as of great artist by being the inaugurator of a revolution in descriptive anatomy. Although he was guilty of many errors both of omission and of commission, he made many important discoveries, among which may be mentioned those of the frontal and maxillary sinuses, the moderator band of the heart, the bronchial arteries, and arteriosclerosis. He was moreover, distinguished from his medieval predecessors and his contemporaries by greater thoroughness, which is particularly illustrated in his studies of individual bones and muscles, as well as by his investigations of the heart, digestive system, brain, and generative organs. As regards Leonardo's place in the history of anatomy, Dr. McMurrich maintains that though Leonardo's influence on the progress of anatomical knowledge was undoubtedly reduced by the fact that his discoveries were not published, it cannot have been entirely lacking, as his studies must have been known to the leaders of scientific thought, such as Pacioli, the Marliani, and the Cardani, who frequented the Florentine and Milanese courts, as well as to his fellow-artists and his colleagues in the Florentine Guild of Physicians and Apothecaries.

Place-Memory shown by Butterflies.—In 1918 William Beebe described what seemed to be a regular homing movement by a zebra butterfly, *Heliconia*, which nightly returned in groups to the same roosting place, and he interpreted his observations as indicating that these butterflies possessed memory, sociability, and caution. During 1930, as well as in preceding years, F. Morton Jones made definite attempts to check Beebe's observations, in the Royal Palm State Park of Florida, where *Heliconia clarithonia* is usually fairly abundant from mid-January to April (*Natural History*, Nov.-Dec. 1930, p. 635). Six roosting places were discovered, and about these, while daylight was failing, the butterflies collected in numbers, filling the air in swirling flight, making preliminary exploring surveys, and finally settling down for the night. The marking of several individuals showed that for several nights in succession the same butterfly may return to a particular twig, but this detailed accuracy of return was by no means a general rule. Was the homing due to place memory or to scent? A simple experiment settled the question. Branches on which a number

of Heliconias had roosted were removed during the day and placed on another bush within the exploring range The butterflies returned at nightfall, circled about the old bush, apparently observed that something was amiss, continued their exploring flights, and finally settled down upon twigs in the old roosting bush Some, during their explorations, paused upon the transferred twigs, only to leave them again and rejoin the flying group After dark, twenty-seven were found in new positions in the old bush, and only one on the transferred twigs, ten feet away Apparently place memory is the guiding power

Teleost Fishes from the Bahamas—Mr Albert Eide Parr has continued his investigations on fishes from the *Pawnee* Expedition's "Teleostean Shore and Shallow-Water Fishes from the Bahamas and Turk's Island" (*Bulletin of the Bingham Oceanographic Collection* Peabody Museum of Natural History, Yale University Scientific results of the third oceanographic expedition of the *Pawnee*, 1927 July 1930) The present portion includes a very large number of fishes, numbering 150 species in all, in which there is one new genus, eleven new species, and one new sub species, besides many rare and little known forms which previously were insufficiently described The new genus *Amphelikturus* is created for Barbour's *Siphostoma dendriticum* and a new species named *Amphelikturus brachyrhynchus* The latter is a handsome fish with dendritic processes on almost the whole of the body, even on the ocular bulbs The genus is closely related to *Halicythys*, differing, however, by the presence of a caudal fin and of protecting processes for the brood pouch. The two genera occupy an intermediate position between the Syngnathinæ and the Hippocampinæ There are, in this paper, valuable discussions on the affinities of certain species, based on careful measurements and colour notes taken from the living fishes

Toxicity of Nicotine to Insects—Previous investigations on the toxicity of nicotine to insects have involved chiefly a study of the effects of its application as sprays or dips, whereby the alkaloid is presented in molecular and ionic form The actual toxic effect has been generally attributed to the entrance of the gaseous molecules into the tracheal system of the insect C H Richardson and H H Shepard, however, describe some experiments (*Journal of Agricultural Research*, vol 41, p 337) with mosquito larvæ, in which the nicotine was presented in aqueous solution only, and in which a wide range in the relative concentration of ions and dissolved molecules was obtained by varying the pH value With aqueous solutions of nicotine of 0 03M concentration an increased toxicity was shown with an increase in pH value, the maximum effect being obtained with pH 9 7 (the free base) Further, at pH 5 0, concentrations from 0 1M to 0 0001M nicotine were five to seven times more toxic than was the sulphate at the same concentration Since these results show that the free base is more toxic than its salts in the absence of the gaseous phase, the view that the greater toxicity of the alkaloid is due to its greater volatility, hitherto put forward by other workers who obtained a similar result with methods including this form, cannot be accepted The speed of the toxic action was found to be directly related to the concentration of the undissociated molecules, so that toxicity is believed to result largely from the penetration of the wall of the alimentary tract by the alkaloid in this form Nicotine ions are also toxic, but considerably less so than the molecules

Eye Colour in *Gammarus*—The eye colour of the wild *Gammarus chevreuxi* is always black, and no variation from the normal black has ever been observed in the many thousands of this amphipod which have been collected in the native habitat of the species at Plymouth This, however, does not preclude the possibility, as is pointed out by E W. Sexton, A R Clark, and G M Spooner (*Jour Mar Biol Assoc*, 17, No 1, Sept 1930), that mutations may have arisen in the wild stock and have disappeared in the struggle for survival The difficulty these investigators have experienced in establishing mutant stocks in the laboratory indicates that the mutations of the type used for genetical study would have but little chance, under normal conditions in Nature, of survival through the early critical period But once established, the mutants tend to become healthier with each generation, and some are able in time to hold their own with the normal wild black-eyed animals in vigour, length of life, and number of offspring The pigment of the eye begins in normal cases as bright scarlet in the embryo and passes through various darkening stages to jet black by the time of hatching In five stocks, all genetically distinct from one another, there have arisen red-eyed specimens in which the red colour persists after hatching The first was observed in 1912, the second, third, and fourth in 1922, and the new mutant stock, dealt with in the present paper, is descended from one of the wild pairs brought into the laboratory in 1928 for temperature experiments The inheritance of this type of red eye, in which intermediate stages and various colour changes occur, is of a complicated kind, and an interpretation in terms of Mendelian genes would clearly involve several genes and interplay of one kind or another among them The matings with this stock have reached the eighth filial generation and the details thereof are clearly set out

Mineral Production of India—To all who are interested in the geology, mining industry, and economics of India the Quinquennial Review of the mineral production of India is a most useful and instructive publication The period under review is from 1924 to 1928 inclusive (*Rec Geol Surv India*, 64, p 446, 1930) The output of coal has slowly but steadily increased since 1925, though unfortunately there has been an equally steady drop in value India is the largest coal producer among the British dependencies The output of petroleum has not varied much, but owing to the marked rise in world production India's percentage contribution has fallen to 0 7 per cent The 1929 figures reveal a notable increase in value, though the world percentage has further dropped to 0 61 per cent The total of the manganese output has gone up, and though the output has risen still further in 1929 the value has dropped, and the industry is at present in a somewhat depressed condition There has been a steady decline in gold production since the early stages of the War period A general increase in the production of lead, zinc, and silver is recorded The output of tin is also increasing, and a slight set back in 1928 was more than recovered in 1929 The quantity and value of iron ore showed a definite improvement India is the second largest producer of iron in the Empire and yields place only to Great Britain Copper also shows a marked increase, continued in 1929 as a result of the activities of the Indian Copper Corporation The report of the mineral production for 1929 is published in the *Rec Geol Surv India*, 63, pt 3, 1930, and brings the Indian statistics up to-date

Recent and Fossil Foraminifera—In the hope of furnishing evidence for the interpretation of fossil faunas, R D Norton ("Ecologic Relations of some Foraminifera", *Bull Scripps Instit Oceanogr*, 2,

pp 331-388, 1930) has studied the conditions affecting the distribution of some 550 species and varieties of Foraminifera found in the Floridan and West Indian regions, ranging in depth from the beach to 2849 fathoms In water of 0 5 fm, where the annual temperature range is 21°-32° C, the Miliolidæ and Peneroplidæ are generally common or abundant, but at 5-60 fm, where the temperature range is 20°-31° C, there is a marked decrease in the number of species and individuals of those families At 500-2850 fm, with a temperature range of only 2°-8° C, the Globigerinidæ and the Globorotaliidæ are predominant The Rotaliidæ and Anomalinidæ are present at nearly all depths and, as families, do not seem to possess much ecologic value J A Cushman and W W Valentine ("Shallow water Foraminifera from the Channel Islands of Southern California", *Contrib Depart Geol Stanford Univ*, pp 1-31, pls i-x, 1930) give an account of the Foraminifera found in shallow water around the islands of Southern California The fauna is related to that of the west coast of South America, and to some extent to that of the West Indian region W P Woodring ("Upper Eocene Orbitoid Foraminifera from the Western Santa Ynez Range, California", *Trans S Diego Soc Nat Hist*, 6, pp 145 170, pls 13 17, 1930) describes new species of *Discocyclina* and *Actinocyclina* from a soft limestone of the western Santa Ynez range The latter genus is widely distributed in eastern United States, the West Indies, and Central and South America, where it is limited to the Upper Eocene H Yabe and S Hanzawa ("Tertiary Foraminiferous Rocks of Taiwan, Formosa", *Sci Rep Tôhoku Imp Univ, Sendai*, ser 2, Geol, 14, pp 1 46, pls 1 16, 1930) record 38 species of Foraminifera from Oligocene and Miocene deposits of Taiwan They belong principally to the genera *Lepidocyclina*, *Miogypsina*, *Gypsina*, and *Operculina*

Cosmic Radiation—Details of fresh measurements of the cosmic radiation are given by Prof R A Millikan in the issue of the *Physical Review* for Dec 1 These have been made partly at Pasadena and partly at Churchill, on the west side of Hudson's Bay and 730 miles south of the magnetic pole A new high-pressure electroscope has been used which gives greater accuracy than Prof Millikan's earlier instruments, and it has been found that the cosmic rays have the same intensity at these two places to within one per cent., it is concluded that they enter the earth uniformly from all parts of the sky, and that, at the outer limit of the atmosphere, they are composed of ether waves and not of electrons The intensity was found to be independent of the positions of celestial objects, but it showed a diurnal variation, going through a maximum every afternoon and a minimum every morning, even after corrections had been made to bring the readings to a common barometric pressure This is attributed to the fact that the barometer is affected by both the temperature and the weight of the superincumbent air, whilst the response of a closed cosmic ray electroscope depends only upon the mass of air above it As Prof Millikan points out, combined cosmic ray and pressure measurements may thus be of much value in meteorology Prof Millikan considers that the observed cosmic ray effects are all in good agreement with the predictions of the Klein-Nishina absorption formula, thus lending support to his hypothesis that the rays are due to atomic syntheses occurring "in the depths of space"

A Variable Capacitance Cylindrical Condenser—In a paper read to the Institution of Electrical Engineers on Jan 7, E B Moullin describes a cylindrical condenser the capacitance of which can be varied gradually through a wide range One cylinder is totally enclosed by the other and their axes are parallel. The axes are coincident when the capacitance is a minimum By moving the axis of the inner cylinder away from the central position the capacitance increases gradually, being a maximum when their axes are farthest apart With the dimensions chosen, the capacitance is increased by one micro-microfarad (1 $\mu\mu$F) by rotating the pointer through 45°, the total change in the capacitance being 16 $\mu\mu$F The capacitance values engraved on the scale are determined by calculation and not by experimental calibration It is shown by electrostatic principles that the end effect capacitance, at least to a first approximation, is constant as the position of the inner cylinder is varied This was verified experimentally by careful tests It was also found possible to use the condenser as a small variable inductance It was found that the residual inductance of the condenser was the twentieth part of a millihenry A method is shown of combining the tubular inductance and the tubular condenser so as to form a robust and self screening short wave wavemeter of small range Experiments prove that the instrument is capable of measuring a wave length correctly to about 0 07 of 1 per cent This practical device is a good illustration of a useful application of mathematics to physics

Draper's Law—The researches of Draper and of Bunsen and Roscoe showed that the rate of photochemical union of hydrogen and chlorine was proportional to the light intensity In 1921 Baly and Barker found that the rate increased faster than the light intensity, but Mrs Chapman in 1924 was unable to confirm this In the December number of the *Journal of the Chemical Society*, Allmand and Beesley describe experiments which agree with Mrs Chapman's results, and they also suggest a possible explanation of those of Baly and Barker

Heterogeneous Equilibria in the Iron-Oxygen-Hydrogen System—The values of the equilibrium constants in the reactions

$$FeO + H_2 = Fe + H_2O$$
$$\text{and } Fe_3O_4 + H_2 = 3\,FeO + H_2O$$

have been determined at various temperatures by Emmett and Shultz, whose experiments are described in the November number of the *Journal of the American Chemical Society* A discussion of previous experiments is given, and the importance of surface effects is emphasised The results are of importance, since, when taken in conjunction with previous experiments on the iron carbon oxygen system, they lead to values for the water gas equilibrium These are calculated and are shown to be in agreement with the directly determined values of Neumann and Köhler, published in 1928

Anhydrous Stannous Chloride—Anhydrous stannous chloride, $SnCl_2$, may be obtained by passing hydrogen chloride over heated tin A more convenient method is described by Stephen in the December number of the *Journal of the Chemical Society* The crystalline hydrate ($SnCl_2$, $2H_2O$, 1 mol) is treated with acetic anhydride (2 mols) Much heat is evolved and the anhydrous salt separates It is washed with dry ether and can then be kept indefinitely in a desiccator The anhydrous chloride, which crystallises in long needles from acetic acid containing a little acetic anhydride, does not appear to be hydroscopic It is soluble in acetone and amyl alcohol, insoluble in benzene, toluene, xylene, and chloroform It dissolves readily in absolute methyl and ethyl alcohols, but a trace of water causes hydrolysis with the formation of an opalescent precipitate

Sea Fisheries Statistics.*

THE statistical tables for 1928 of the sea fisheries of the north and west of Europe, brought together and edited by Prof D'Arcy Wentworth Thompson, show much that is of interest By a recent resolution of the International Council, "the value and quantity of fish landed in each country is now and henceforth to mean only such fish as is landed by the fishing-fleets of that country, all fish caught by the vessels of any particular country are credited to that country, whether they be landed at home or abroad, and (for instance) trawled fish landed by a German at Aberdeen is treated as part of the German catch and not of the Scotch " This does away with a statistical difficulty which in some countries, notably Great Britain and Germany, was serious

The total values of the fisheries of northern and western Europe (including Portugal) amounted in 1928 to nearly £47,000,000, and the total quantity of fish landed was rather more than 3,300,000 English tons Using the returns of the year 1913 as a normal standard of comparison, the money value of each catch was 46½ per cent above that of 1913, 6 per cent greater than in 1927, and the largest figure since 1924, but it was much less than the total earnings of the fisheries during the inflated prices of the years 1918–1920 These total values and quantities are unaffected by the change of statistical method, but this change affects the returns of some of the individual countries In Great Britain the value of the fisheries has increased to an extent nearly sufficient to compensate for the deduction of value due to foreign landings The total quantity of fish landed in 1928 is the largest on record for most of the countries concerned, as that for 1927 had been in its turn, exceeding the catch of 1913 by about 20 per cent All countries show an increased catch in 1928 except Great Britain and France The average price was the same in 1927, about 20 per cent above the average price in 1913 Of the more important fishes, herring alone in 1928 is at a lower average price (about 7 per cent lower) than in 1913 Trouble in the herring market and difficulties of export trade account for this

In the North Sea fisheries the catch increased steadily until 1913, when it reached its maximum of a million and a quarter tons During the War the landings were reduced to less than half By 1920 the pre-War catch was nearly equalled, but again went down in 1921 and 1922 Since then the catches have increased, and in 1928 amounted to 91 per cent of the 1913 totals The net fishery (to all intents and purposes identical with the herring fishery) is all but equal to that of 1913, the line fishing has increased considerably, but the trawl landings are no more than 85 per cent of those of 1913 The Danish seine came into use later, and only found its place as a separate entry in the tables in 1925 Within the last four years this fishery has not increased, but not diminished to any serious extent, and rather more fish were landed in 1928 from the North Sea by means of the Danish seine than by the line fishery

Herring, haddock, cod, and plaice are the most important fishes in most of the countries concerned, yielding more than half of the whole revenue except in France, Belgium, Poland, and Portugal The tables showing the share contributed by these fishes to the total fishery revenue vary little from year to year The herring fishery in the North Sea is not so great as it was—at least in its relative importance—but is not going back, and for the last three or four years its relative share of the total value has been slowly but steadily rising The fluctuations in the relative shares of the various countries in the North Sea catch are chiefly due to the herring The catch of herring was a good one in 1928 in both the Kattegat and the Skagerrak, and herring constituted very nearly two-thirds of the whole quantity of fish landed from the North Sea Haddock was higher in 1928 than in 1913, both in quantity and value, cod had risen in total value but fallen in quantity, plaice and sole had both improved in relative quantity and value

Very high figures are shown for 'small' plaice from the trawlers, especially in Holland, and these tend to increase, this is also the case for the haddock, the cod increasing much after 1913, but dwindling again in 1928

Part 2 is occupied with tables of general statistics, and there is a list of the common names of the fishes as used in the different countries

* Conseil Permanent International pour l Exploration de la Mer 'Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l Europe Publié par le bureau du Conseil Vol 18, pour l année 1928 (Copenhagen Andr Fred Høst et fils, 1930)

The Timber of Corsican Pine.

CORSICAN pine (*Pinus Laricio*) is being planted in Britain at the present day on a very considerable scale, especially under the auspices of the Forestry Commission In fact, it is being given preference, owing to the greater rapidity of growth, over the indigenous pine, the volume of Quality I Corsican being 40 per cent greater than for the same quality Scots pine In how far this action will prove justifiable must be left to the future to disclose Those who are paying serious attention to the question will welcome *Bulletin* No 6, "The Timber of Corsican Pine", of the Forest Products Research Laboratory (London H M Stationery Office, 1930 2*s* 6*d* net), which gives the results so far attained in the study made in the laboratory of the timber of Corsican pine grown in Great Britain As the introduction to the bulletin rightly says "The extensive plantations of this species that are being formed throughout Great Britain will in time yield a considerable quantity of timber, and it is important to know what are the characteristics of this timber as grown in this country and hence for what purposes it is suited"

Fortunately, there are in existence plantations of sufficient age to enable timber tests to be carried out, for though it is only during the last fifty years that it has been at all extensively planted, the species was introduced into England about 1759 The timber used for the mechanical tests was obtained from a plantation on Lord Leicester's estate at Holkham and from the New Forest, near Knightswood The value of this species for pit props has also been investigated, the material for the purpose being obtained through the Forestry Commissioners from the Forest of Bere, Leuchars, Fife, and the Forest of Dean The pit props from these two areas were compared with imported props from Scandinavia and the Baltic

For the very interesting and important data which have so far been obtained from the investigations carried out reference must be made to the bulletin The conclusions arrived at are summarised as follows.

The timber is moderately light, very resinous, with a texture somewhat coarser than Scots pine. It can be readily seasoned, either in the open or in the kiln The timber has a tendency to take on a deeper tinge if high temperatures are used, but this does not neces-

-sarily prove detrimental to its use It can be readily air seasoned, but, as the sapwood is liable to blue stain, the logs must be converted as soon as possible after felling, and similarly seasoning should proceed as rapidly as possible after conversion In the case of air-seasoning, open stacking is recommended

*Although the timber has a strength equal to the average pines, except the pitch pines, it is not so strong as Scots pine or home grown Douglas, a point requiring careful consideration It is inclined to be brittle and consequently should not be used in positions where it would have to resist the application of sudden loads or shocks As a mechanical timber it is probably of most use as a post, where its strength in compression parallel to the grain is almost equal to that of the Scots pine Corsican pine takes readily either creosote or water solutions The timber works easily under all tools and takes a finish equal to Scots pine There is, however, a considerable proportion of sapwood and this is more difficult to cut than the heartwood The frequency of knots detracts also from the appearance in finishing any large surface of timber The knots are to a considerable extent due to faulty methods of growth in the past, and this defect should be eliminated in the future It is said that the timber would then be suitable for all classes of finer joinery in which Scots pine is at present used It would also be useful for boxes, packing cases, and crates Owing to the readiness with which it takes creosote, it has a possible future as railway sleepers

As regards pit props, this timber, when carefully graded (the latter point is of first importance), is equal to Scots pine and compares favourably with imported props of the same grade The props must not be left with the bark on for any considerable time

To those interested in the afforestation question and to the future uses to which the timbers of the species now being planted may be put, a study of this bulletin should prove of the greatest interest It also furnishes evidence of the important nature of the work being undertaken by the Forest Products Research Laboratory at Princes Risborough

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Annual Conference of the Geographical Association

THE annual conference of the Geographical Association was held at the London School of Economics on Dec 31–Jan 3, and was followed by a week end visit to St Albans There could be few more adequate tributes to the vitality of the modern science of geography and the increasing recognition of its importance in all walks of life than the steadily expanding activities of this annual gathering It is estimated that between five hundred and six hundred members took part, and more than a hundred sat down to the annual dinner on Jan 2, whilst the publishers' exhibition was larger than on any previous occasion It is significant of the mutual appreciation of two bodies engaged in spreading knowledge of the earth as the environment of man and the responsibilities of the voter of to-day as a citizen of the world, that the opening gathering of the conference took place in the galleries of the Imperial Institute Here, members and their friends were welcomed by Lieut General Sir William Furse

Mr B B Dickinson, in his presidential address, dealt with the early history of the Association, modestly attempting to disclaim his title of founder His interesting account of the steps by which geographical teaching has been improved and of how the interests of teachers were watched by the young Association was provided with a sequel at the annual dinner by the announcement of a presentation shortly to be made to Miss R M Fleming Under the guidance of Prof H J Fleure as honorary secretary, no one has done more to further the work of the Association—its membership of more than 4000, its library, its lantern-slide collection, and its branch organisations —than Miss Fleming Very appropriately, her recent travels in Russia provided some of the material for a very able account of the geographical regions of the country, a lecture which attracted many more than could be admitted

In the annual report, reference was made to the transfer of the headquarters to Manchester, and to the acceptance by Sir Leslie Mackenzie of the presidency for 1931 Mr J Fairgrieve reported on the work of the Commission on Educational Films, holding that the present day teachers must in any case face the problem of using films for a generation of children already film minded as freely as they would a black board Dr L D Stamp, as the director of the Land Utilisation Survey of Britain, referred to that organisation as having grown naturally out of a committee of the Association It is the primary object of the survey to record on the 6 inch Ordnance Survey maps the uses to which the surface of the country is applied, the uses being grouped under half a dozen simple categories So far as possible, county education authorities are being asked to organise the work, which has the approval, amongst others, of Sir Charles Trevelyan, Sir Henry Richards, the County Councils' Association, and the Forestry Commission It is hoped to publish the results as a series of map sheets on the scale of 1 inch to 1 mile

Amongst other lectures may be mentioned Major Hingston's on the investigation of the life of the 'roof' of the equatorial forests of Guiana, Miss Butcher's description of the methods of the study groups organised by Leplay House (Institute of Sociology) as exemplified by surveys made amongst the Chod villages of Bohemia, and Dr P W Bryan's study of population groupings in Britain Dr Bryan maintains that the human habitations marked on the 1-inch Ordnance Survey maps show a characteristic grouping according to the dominant occupation of the area the grouping for example being different in areas of arable farming, pastoral farming, or mining An important series of original maps, showing on the dot method the principal areas of production of the leading crops of Scotland, was exhibited by Mr H J Wood Amongst the group discussions, that on school journeys, which was combined with an exhibition of photographs and work carried out by pupils taken on such journeys, was of special interest

After the termination of the London meetings, about forty members paid a visit to St Albans, where they were received by Sir John and Lady Russell and members of the St Albans Rotary Club An examination of the site of the Roman city (Verulamium) afforded an opportunity of discussing the geographical factors which helped to determine the site of the city on the now elm lined meadows beyond the Ver, and of the Saxon church of St Michael After a visit to the Herts County Museum, the party was received by the Mayor and Mayoress, and a lecture was given by Mr Woolley on the life of St Albans, based on the manuscripts of Matthew Paris On Sunday, after attending a civic service at the cathedral, the house and grounds of Gorhambury (Bacon's home) were seen under the personal guidance of Lady Verulam, and an address on Bacon and his times, given by Sir Richard Lodge, was greatly enjoyed On Monday, after

seeing the cathedral, the party made a tour, visiting especially the Gade Valley, "one of the most interesting valleys in England for the student of transport" Above Tring, from the chalk scarp, an excellent view of the plain was obtained, the richly cultivated chalk-marl terrace with its row of old villages standing out clearly The tour finished with a visit to Rothamsted Experimental Station under the guidance of Sir John Russell

L Dudley Stamp
E E Evans

University and Educational Intelligence.

Cambridge —The Appointments Committee of the Faculty of Medicine has reappointed Dr A E Barclay, of Christ's College, to be University lecturer in medical radiology and electrology

Dr F G Mann, of Downing College, has been elected to a fellowship at Trinity College Dr Mann, who was formerly assistant to the professor of chemistry, is a University lecturer in chemistry

Glasgow —On Tuesday last, at a ceremony in the Randolph Hall of the University, Sir Frederick Gowland Hopkins, president of the Royal Society, presented, on behalf of the subscribers, to Prof Robert Muir, his portrait by Mr G Fiddes Watt, and to the University a bust by Mr G H Paulin

London —The Court has accepted, on behalf of the University, the generous bequest of £4000, free of legacy duty, from the late Miss Mary Ethel Sim Scharlieb, who died on May 31, 1926 The purpose of the bequest is the founding of a scholarship in memory of Miss Scharlieb's mother, the late Dame Mary Ann Dacomb Scharlieb, to whose life interest the legacy was subject The conditions of award are to be determined by the University

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The eighteenth series of *Methods and Problems of Medical Education* has been issued by the Rockefeller Foundation, New York, U S A This volume deals particularly with institutes and laboratories of physiology and physiological and bio chemistry, together with some pathological and other special departments, in all parts of the world As in previous series, descriptions of the laboratories are given, with illustrations and plans, and in some instances the staffing and budgets of the departments are appended

The annual report of the University of Leeds to the Worshipful Company of Clothworkers of the City of London on its textile industries and colour chemistry and dyeing departments will be read with additional interest in view of the recent controversies regarding the Dyestuffs Act of 1920 Both departments showed a falling off in the number of day students, and the textile industries department's enrolment of evening students decreased from 110 to 94 They both report, however, a brisk demand for the services of their past students, and the colour chemistry and dyeing department could have placed in suitable positions more students than were ready for employment Great interest was taken in the work of the department by numerous firms, which not only consulted its head when vacancies occurred in their staffs, but also gave a great variety of chemicals, artificial silks, and other textile materials, machinery, etc All students awarded research scholarships in recent years have completed arrangements for their employment in industry some months in advance of leaving the Department Attached to the report is a list of publications by members of the departments

Birthdays and Research Centres.

Jan 25, 1875 —Mr S S Cook, F R S, technical manager of the Parsons Marine Steam Turbine Co

The chief objects of present investigations are the development of high pressure turbine machinery for marine propulsion, and the investigation of thermodynamic and hydrodynamic problems, including cavitation and water hammer erosion.

Jan 26, 1885 —Mr H R Ricardo, F R S, technical director of Ricardo and Co, Ltd, consulting engineers

At present I am occupied chiefly with the design and development of light, high speed, heavy oil engines for all mobile purposes This problem includes an investigation into the factors controlling combustion under the conditions of compression ignition, in relation both to combustion chamber design and to the preparation of suitable fuels

Jan 27, 1856 —Prof Edward B Poulton, F R S, Hope professor of zoology in the University of Oxford

My chief object is to bring together and publish in a series of parts the observations on the bionomics of insects which have appeared scattered through many journals and books during the past forty five years, especially those which deal with protective (cryptic) resemblance, warning (aposematic) characters, and mimicry, both Mullerian (synaposematic) and Batesian (pseudaposematic), also with epigamic characters and their display or manifestation in other ways I hope to be able to include such interesting new observations on these subjects as are likely to be recorded in the near future

Jan 27, 1864 —Prof J W Gregory, F R S, lately professor of geology in the University of Glasgow

I am at present in a transitional stage, for, having recently resigned my chair, I am hoping for leisure to work at several problems which have always specially interested me In the meanwhile, I am trying to finish some arrears of incomplete work, such as a paper on the sequence of the Dalradian rocks of the Southern Highlands of Scotland, and a paper on the australites or obsidian buttons of Australia Later I hope to secure leisure for work on some problems of general geomorphology, including the analogies in tectonic structure of Africa and South America, and complete a study of the geological history of the oceans, of which two sections were dealt with in an address to the Geological Society I have also material collected at various times and still undescribed

Jan 30, 1851 —Dr Henry Ogg Forbes, consulting director of museums to the Corporation of Liverpool

For some time I have been incapacitated from undertaking any new scientific or literary work, owing to the painful results of the collapse of a chair in the British Museum Reading Room Should, however, the surgical operation proposed restore me, as anticipated, to some measure of relief, I look forward hopefully to publishing the ethnographical and geographical observations made in Sokotra (indicated in the preface to "The Natural History of Sokotra and Abd-El-Kuri") and in Peru

Societies and Academies

LONDON

Royal Society, Jan 15 —**Lord Rayleigh** Iridescent colours of birds and insects The reflection spectra of various brilliantly coloured insects have been examined in the ultra-violet *Morpho* butterflies and *Urania* moths show ultra violet maxima in general agreement with the theory of interference Iridescent beetles showing a deep red colour at normal incidence may be made to pass through all the colours of the spectrum to violet, provided that arrangements are made to annul refraction at the air chitin surface Some of the golden beetles show transmission spectra of bands which vary continuously in position with the part of the specimen examined Moist chlorine gas does not destroy the colours of *Morpho* or of *Urania*, though the black background is bleached nor does chlorine decolorise the metallic beetles The colours of all kinds of feathers, however, are rapidly discharged Peacock feathers undergo a progressive change of colour in ultra violet light or long continued sunlight Generally speaking, the colours become more refrangible Other feathers, even when blue, are slowly decolorised without change of refrangibility *Morpho* butterflies and *Urania* also lose colour without change of refrangibility Fading under light or chlorine in these cases would seem to favour the idea of a pigment, but it is attributed to the breaking down of an interference structure —**O W Richardson** and **L G Grimmett** The emission of electrons under the influence of chemical action at lower gas pressures A method is described by which partial pressures of phosgene can be controlled and their changes measured down to 10^{-5} mm mercury The electron emission from NaK in this gas has been measured down to directly measured pressures of 10^{-5} and to extrapolated pressures of 5×10^{-7} mm under various conditions In contrast to the results at pressures above 10^{-3} mm, the emission is now found to be a function of the gas pressure as Richardson originally supposed The experimentally determined velocity distribution function among the electrons approaches a limit as the pressure is reduced —**A J Allmand** and **A Puttick** The sorption of carbon tetrachloride at low pressures by activated charcoals (Part 4) Work has been done on the effect of high temperature evaluation on the nature of vapour isothermals on charcoal It has been found that the carbon tetrachloride isothermal on at least one charcoal has a discontinuous structure If a sufficiently high charging pressure of sorbate is used, a reversible isothermal can be obtained —**D Marshall** and **Sir Thomas Stanton** The eddy system in the wake of flat circular plates in three dimensional flow The paper describes experiments on the flow of water in steady motion past flat circular plates normal to the direction of motion The nature of the flow is rendered visible by colouring the streams, and simultaneous photographs on two planes at right angles of the motion in the wake of the plates were obtained At speeds lying between a well defined upper limit and a lower limit well above that corresponding with a state of flow in which the inertia terms are negligible, a permanent vortex ring was observed at the back of the plate When the speed exceeded the upper limit the substance of the ring was discharged downstream in a series of vortices of definite pitch and periodicity —**J Chadwick**, **J E R Constable**, and **E C Pollard** Artificial disintegration by α particles The protons emitted by certain elements when bombarded by α particles have been examined by an electrical method Except in the cases of fluorine and sodium, the disintegration protons consisted of different groups The origin of these groups is explained on the assumption that the protons and α particles contained in a nucleus are in definite energy levels The mass defects of certain nuclei formed in the disintegration processes are deduced

Physical Society, Dec 5 —**C A Kloss** Relations between the fundamental physical constants The numerical values of the fundamental physical constants have been expressed in forms all of which involve, exactly or approximately, the quantity 10^{-13}, and some possible inferences from these values have been suggested —**W A Wood** The influence of the crystal orientation of the cathode on that of an electro deposited layer This is studied by X ray methods for copper and nickel, respectively deposited on rolled copper The conditions of cathode surface and current density which accompany an oriented deposit are determined The orientation of the copper deposit for small currents is the same as that of the cathode The nickel, at low current densities assumes a distinct orientation As the current is increased there is a region of no orientation, followed at still higher currents by one exhibiting the same orientation as that of the cathode surface below —**B K Johnson** Sources of illumination for ultra violet microscopy Experiences encountered in an attempt to find means for reducing the exposures hitherto necessary in ultra violet microscopy are described Amongst the subjects dealt with are quantitative measurements of the relative intrinsic brightness of spectrum lines given by various sources of radiation methods of producing a monochromatic source suitable for this work, the steadiness of the illuminant the effect on the definition of the image when a triple spectrum line is used as a source, the study of electrical conditions for the production of increased brightness of the spark, such as the effects of change in frequency, secondary potential, capacity, and energy input, and the production of a compact and inexpensive electrical unit for use with the ultra violet microscope

PARIS

Academy of Sciences, Dec 8 —**P Villard** The titration of phosphoric acid A study of the reaction of phosphoric acid with solutions of caustic soda, lime, and baryta in the presence of various indicators —Emile Jouguet was elected a member of the Section of Mechanics in succession to the late M Sebert Sir Arnold Theiler was elected *Correspondant* for the Section of Rural Economy in succession to the late Paul Wagner —**G Pfeiffer** The generalisation of the method of Jacobi Mayer —**Georges Giraud** Extension of the results concerning certain problems of data at the frontier —**J A Lappo-Danilevski** Meromorph functions of matrices —**Ridder** Some theorems on primitive functions —**E Gugino** The determination of the forces of reaction in the movement of a material system —**Michel Vacher** The modifications in the fine structure of a spectral line brought about by molecular diffusion Study as a function of the angle of diffusion —**Jean Cabannes** The fine structure of a spectral line after molecular diffusion —**Charles Dufraisse** and **Raymond Horclois** The catalysis of autoxidation the antoxygen or pro oxygen actions of iron and its compounds The catalytic activity of iron varies, both in intensity and sign, with the nature of the salt employed, and also with the nature of the autoxidisable materials with which it is in contact —**André Courty** Study of the casting of light aluminium alloys The influence of chemical composition —**L Lematte**, **G Boinot**, **E Kahane**, and **Mme M Kahane** The phosphotungstates and silico-

tungstates of some quaternary bases Analytical applications Choline and several substitution derivatives of choline form precipitates with phosphotungstic acid and with silicotungstic acid These precipitates are sufficiently constant in composition to be used in analysis —**E Carrière and Juillard** The action of sodium thiosulphate upon potassium iodate in faintly acid solution —**Georges Laude** The synthesis of cyanic acid and of urea by the ammoniacal oxidation of carbon Carbon was prepared from camphor soot purified by extraction with benzene and ether, and finally raised to a dull red heat in a vacuum Acetylene carbon was also used The oxidation was effected by copper powder and potassium permanganate in the presence of concentrated ammonia The cyanic acid produced was estimated as dixanthylurea 100 grams of camphor carbon gave 11 per cent and acetylene carbon 6 per cent of cyanic acid —**Conrad Kilian** An element of decision for the controversy concerning the Plio Pleistocene Saharan sea Since the work of Pomel and of Flamand, the hypothesis of Plio Pleistocene marine penetration of the Sahara has been regarded as completely disproved The observations of the author now described reopen the question the marine hypothesis is still worthy of attention —**M Thoral** New observations on the age of the limestones of the Monts de Lacaune —**E Bruet** Observations on the continental alteration of certain sediments —**J Thoulet** The water cycle liquid columns and cones of gyration —**J P Rothé** The geological interpretation of magnetic measurements in the Paris basin —**Pierre Chouard** The regeneration of small bulbs on the green leaves of certain Liliaceæ The mutilation of the bulb has been used as a means of determining a more active production of buds and small bulbs, but this destroys the mother bulb The author describes a method of producing the small bulbs on the green limbs of the leaves without destroying the mother plant —**Charles Pontillon** The variations of the fatty acids of *Sterigmatocystis nigra* as a function of the mineral composition of the culture fluid **M Bridel and C Charaux** The preparation and properties of the franguloside (frangulino) of commercial alder buckthorn bark A method is described for extracting franguloside from the bark by which the yield is much increased (25 grams per kilogram instead of 1 gram) **R Fosse, A Brunel, P de Graeve, P E Thomas, and J Sarazin** The presence of allantoin, with or without allantoic acid, allantoinase, and uricase, in numerous plants used for food —**W Kopaczewski** The reduction of the capillary buffer action of cancerous serum —**A Bakke, Mlle V Aschehoug, and Chr Zbinden** A new factor of nutrition **Ph Joyet-Lavergne** The notion of somatic sexualisation —**Georges Blanc and J Caminopetros** The transmission of Mediterranean kala azar by a tick *Rhipicephalus sanguineus* —**Joseph Thomas** Injections of cancerous autolysates in the treatment of cancer Clinical observations of cases submitted to injections under the treatment described in an earlier paper The author regards his results as proving that a cancerous tumour is the local expression of a general disease —**F Vlès and A de Coulon** Researches relating to the effects of certain amino acids on the isoelectric points of human serum

ROME

Royal National Academy of the Lincei, June 15 —**U Cisotti** Isotropic quadruple tensors —**G Bruni and G Natta** Crystalline structure of benzene and its relations to that of thiophen (2) The results of X ray examination of solid benzene at $-170°$ by the powder method show that the unit cell is of bipyramidal rhombic form of sides $a = 7\ 34$, $b = 9\ 52$, and $c = 6\ 74$ A, corresponding with the axial ratio $a\ b\ c = 0\ 771\ 1\ 0\ 708$, which differs but little from that determined by Gordon Cox at $-22°$, the density is calculated to be 1 099 No true isomorphism exists between benzene and thiophen, but analogies are evident between the dimensions of the unit cells of the rhombic benzene and the tetragonal thiophen, which have volumes of 471×10^{-24} c c and 498×10^{-24} c c respectively The radiations of long wave length furnished by a metallic calcium anti cathode proved of advantage in the measurements —**G De Lorenzo** The geological cause of the disappearance of the ancient city of Paestum It is now generally thought that the ancient Greek city of Poseidonia, which later became the Paistum of the Lucanians and the Paestum of the Romans, owed its disappearance, not to barbaric invasions and incursions of Saracens, but to conquest by malaria Study of the variations of the sea level observed during historical times along the Tyrrhenian coast of southern Italy indicates that, in the sixth century B C, the surface of the travertine deposit on which this city stood was at least 25 metres above sea level, whereas it is now buried under a deep layer of material of river and marshy origin, cemented by infiltrations of calcareous tufa —**L Petri** An extensive infection of *Pythium* on grain plants —**D Montesano** The normal descendences of geometrical Cremonian groups —**Fausta Audisio** Calculation of π by Leibniz's series —**C Popovici** Remarks on integro functional equations —**Enrico Volterra** The influence of several rigid nuclei immersed in an elastic medium —**B Finzi** The deformation tensor of a film —**M Pierucci** The orbit of the trans Neptunian planet The author's rule, that the distances of the planets—taken in the two groups of internal and external planets—from the sun increase in whole numbers, gives a lower mean error than any other known rule Better agreement with this rule is obtained when it is applied to the geometrical mean of the two semi axes of the orbit, which is termed the 'equivalent radius' If this magnitude for Lowell's planet is taken as the mean of the values given by Banachiewicz and Crommelin, the value of the unit of measurement which renders minimum the sum of the squares of the errors is the same for the four old external planets as when Lowell's planet is included, the mean error of the rule being thus sensibly lowered by the discovery of the new planet —**B Gulotta** The rigorous development, in series of spheric functions, of the external potential and the surface gravity of a spheroidal (not of rotation) planet —**G Bernardini** Characteristic velocities of the electrons diffused by metallic surfaces —**G Racah** Quantistic electrodynamics **G R Levi and D Ghiron** Reduction cells of alkali chlorites Values are given for the reduction potentials at 20° of chlorites with certain reagents in practically neutral solution, neutrality being maintained, when necessary, by means of buffer solutions of sodium borate and magnesium sulphate, and bright platinum electrodes being used —**A Ostrogovich and V Galea** Investigations on γ-triazines Synthesis of arylamino thioltriazines Descriptions are given of five new arylaminothioltriazines, prepared by the condensation of cyanoguanidine with the corresponding arylthio acids —**A Migliavacca** Regeneration of the central nervous system before and after birth

MELBOURNE

Royal Society of Victoria, Nov 13 —**Jean Heyward** Flowering periods of Victorian plants A graphical record was made of the flowering periods of all Victorian genera of plants From these graphs were constructed tables to test a theory put forward by

Illichevsky He considers that plants flower in the order of their phylogenetic evolution the most highly developed plants, being more complex, require for their development a longer time and a greater quantity of warmth than simpler ones, and hence they will flower later in the summer This was not found to be the case with the Victorian flora —**Cedric Deane** Australian Hydrophilidæ In this paper are described nine new species of *Ochthebius*—*O clarki*, *O angustipennis*, *O tenebricosus*, *O longipes*, *O obcordatus*, *O clypeatus*, *O pallidipennis*, *O leai*, and *O fischeri*, also one new *Hydræna*, *H williamsensis* These belong to the section in which the members, though living in the water, do not swim but cling to sticks, stones, and reeds Being winged, it is presumed that they fly by night like their relatives of the swimming section The total number of Australian Ochthebii is now thirteen, and the Hydrænæ six —**Charles Oke** On some Australian Curculionidæ Four new genera are described—*Mandalotina*, *Daylesfordia*, *Dixoncis*, and *Nyella* Also twenty four new species Three new species are referred to the New Zealand genus *Phrynixus*, not previously known in Australia

SYDNEY

Royal Society of New South Wales, Nov 5 —**George Smith** Notes on the mineralogy of the silver lead zinc deposits of New South Wales, with special reference to the Barrier Ranges Silver Field This paper describes the occurrence of the ores and associated minerals, especially at Broken Hill, and particularly the manner in which the ore bodies have been affected by descending solutions, their destructive action on the original minerals contained in the lodes and the production of new mineral combinations The relation of the minerals to the lode gangue is discussed at some length as well as the nature and causes of the secondary enrichment, which was such an important feature of the oxidised zone in the Broken Hill mines

Official Publications Received

BRITISH

India Meteorological Department Scientific Notes Vol 2 No 15 Winds in Higher Levels over Agra By Dr N K Sur Pp 36 43+11 plates 1 rupee 1s 9d Vol 2 No 16 Winds in the first 3 km over Port Blair By K P Ramakrishnan Pp. 46 63+2 plates 12 annas 1s 3d Vol 2 No 17 Tables of Monthly Average Frequencies of Surface and Upper Winds up to 8 km in India. Part C Pp 195 232 14 annas 1s 6d Part D Pp 235 272 14 annas 1s 6d (Calcutta Government of India Central Publication Branch)

The Newcomen Society for the Study of the History of Engineering and Technology Transactions, Vol 8 1927-1928 Pp. xi+196+23 plates (London) 20s

Department of Agriculture Straits Settlements and Federated Malay States General Series No 3 Technical Reports for the Year 1929 Pp iii+79 (Kuala Lumpur)

The Chemist and Druggist Diary, 1931 Pp 488+Diary (London)

Report on the Operations of the Department of Agriculture Madras Presidency, for the Year 1929 30 Pp ii + 40 + 4 plates (Madras Government Press) 14 annas.

Indian Central Cotton Committee Technological Laboratory Technological Bulletin, Series A, No 17 Limit Spinning Tests on Cambodia and Mollisoni Cottons By R P Richardson and Dr A James Turner Pp ii+24 (Bombay) 1 rupee

The Journal of the Astronomical Society of South Africa Edited by Dr H Spencer Jones Vol 2, No 5, November Pp 213 264. (Cape Town) 2s

Report on the Administration of the Meteorological Department of the Government of India in 1929 30 Pp 25 + 4 plates (Calcutta Government of India Central Publication Branch) 1 rupee 1s 9d

Indian Journal of Physics, Vol 5 Part 5 and Proceedings of the Indian Association for the Cultivation of Science Vol 14 Part 5 Conducted by Sir C V Raman Pp 473 572 (Calcutta) 1 12 rupees 2s 4d

Transactions of the Institute of Marine Engineers, Incorporated Session 1930, Vol 42 December Pp 889 958+xliv (London)

Indian Journal of Physics, Vol 5, Part 6 and Proceedings of the Indian Association for the Cultivation of Science Vol 14, Part 6 Conducted by Sir C V Raman Pp 573 668 (Calcutta) 1 8 rupees 2s

Department of Scientific and Industrial Research Report of the Water Pollution Research Board for the Year ended 30th June 1930 with Report of the Director of Water Pollution Research Pp iii+33 (London H M Stationery Office) 9d net

Publications of the Safety in Mines Research Board Vol 5 1929 Reports and Papers relating to Research into Coal Dust, Firedamp and other Sources of Danger in Coal Mines. Pp 10 (London H.M Stationery Office) 2d net.

Imperial Department of Agriculture for the West Indies Report on the Agricultural Department St Lucia, 1929 Pp iv+29 (Castries, St Lucia Government Printing Office) 6d

Journal of the Chemical Society December Pp iv+2583 2791+x (London)

British Industries Fair 1931 Olympia London W 14 February 16th to 27th Organised by the Department of Overseas Trade Special Overseas Advance edition Pp xvi+416+Ad 178+Ad xvi (London Department of Overseas Trade) 1s

British Industries Fair 1931, Birmingham February 16th to February 27th Organised by the Chamber of Commerce, Birmingham, being an Integral Part of the Board of Trade British Industries Fair Advance edition Pp 241+iv+204 (London Department of Overseas Trade) 1s

FOREIGN

Smithsonian Miscellaneous Collections Vol 84 A History of Applied Entomology (somewhat Anecdotal). By L O Howard (Publication 3065) Pp viii+564+51 plates (Washington, D C Smithsonian Institution)

Report of the Aeronautical Research Institute Tokyo Imperial University No. 64 Ensuigata Rappa no Onkyogakutekino Seisitu ni tuite (Sono 2) (On the Acoustical Properties of Conical Horns Part 2) By Kozi Satô Pp 261 285 0 19 yen No 65 Action of Antioxygens in the Oxidation of Unsaturated Fatty Oils 2 Inhibitory Effect of Diphenylamine Diphenylguanidine and Hydroquinone By Bunnosuke Yamaguchi Pp 287 305 0 15 yen (Tokyo Koseikai Publishing House)

The Science Reports of the Tohoku Imperial University Sendai Japan Fourth Series (Biology), Vol 5 No 3 Pp 423-614+plates 15 20 (Tokyo and Sendai Maruzen Co Ltd)

Proceedings of the Imperial Academy Vol 6, No 8 October Pp xxv xxvi+297 355 (Tokyo)

Comptes rendus des travaux du Laboratoire Carlsberg 18me Vol, No 5 Pp 124 (Copenhagen H Hagerup)

U S Department of Commerce Coast and Geodetic Survey Annual Report of the Director United States Coast and Geodetic Survey to the Secretary of Commerce for the Fiscal Year ended June 30 1930 Pp ii+47+10 plates (Washington, D C Government Printing Office) 60 cents

Scientific Papers of the Institute of Physical and Chemical Research No 274 Studies on the Adsorbed Moisture by the Kanbara Clay By Hajime Isobe Pp 229 274 50 sen Nos 275 276 On a certain Wax in Rice Polishings by Umé Tange An Erratic Phenomenon of the Spark over Voltages in the Sphere Gap (Abridgement) by Takeshi Nishi and Yoshitane Ishiguro Pp 275 286 20 sen No 277 On the Analysis of the Aluminium Group By Sunao Atô Pp 287 311 40 sen (Tokyo Iwanami Shoten)

Bulletin of the Vanderbilt Marine Museum Vol 3 Scientific Results of the Cruises of the Yachts *Eagle* and *Ara* 1921-1928 William K Vanderbilt Commanding Crustacea Anomura Macrura Schizopoda Isopoda, Amphipoda, Mysidacea Cirripedia and Copepoda By Lee Boone Pp 221+83 plates (Huntington L I)

Proceedings of the United States National Museum Vol 77 Art 16 On Dinosaurian Reptiles from the Two Medicine Formation of Montana By Charles W Gilmore (No 2839) Pp 139+10 plates Vol 77 Art 18 New Species of North American Weevils of the Genus Lixus By F H Chittenden (No 2841) Pp. 26+1 plate Vol 78 Art 5 New and Old Land Shells from the Island of Luzon Philippines By Paul Bartsch (No 2848) Pp 20+9 plates. Vol 78, Art 6 The South American Lizards in the Collection of the United States National Museum By Charles E Burt and May Danheim Burt (No 2849) Pp 52 (Washington D C Government Printing Office)

United States Department of Agriculture Technical Bulletin No 212 Mechanical Analysis of Finely Divided Natural Phosphates By Lyle T Alexander and K D Jacob Pp 24 (Washington D C Government Printing Office) 5 cents

Smithsonian Miscellaneous Collections Vol 82 No 9 The Further and Final Researches of Joseph Jackson Lister upon the Reproductive Processes of *Polystomella crispa* (Linné). (An unpublished Paper completed and edited from his Note Books) By Edward Heron Allen (Publication 3067) Pp 11+7 plates (Washington D C Government Printing Office)

University of California Publications in American Archaeology and Ethnology Vol 24 No 9 Yuki Basketry By Isabel T Kelly Pp. 421 444+plates 120 127 Vol 30 Klamath Ethnography By Leslie Spier Pp viii+338 4 00 dollars (Berkeley Cal University of California Press London Cambridge University Press)

Forty sixth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution 1928 1929 Pp vii+654 + 80 plates (*Washington D C Government Printing Office*) 1 90 dollars

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 82 Cerions of Andros Bahamas by Henry A Pilsbry and Maurice Black List of Land and Freshwater Mollusks collected on Andros, Bahamas by Henry A Pilsbry Pp 289 302 Anatomy and Relationships of some American Helicidae and Polygyridae By Henry A Pilsbry Pp 303 327 The Resident West Indian Warblers of the Genus Dendroica. By James Bond Pp. 329 337 Results of the Pinchot South Sea Expedition—II Land Mollusks of the Canal Zone the Republic of Panama and the Cayman Islands by Henry A Pilsbry, South American Land and Freshwater Mollusks Notes and Descriptions —VII by Henry A Pilsbry Pp 339 365 Descriptions of New Birds from Peru and Ecuador By M A Carriker Jr Pp 367 376 (Philadelphia Pa)

Zentralanstalt für Meteorologie und Geodynamik Publikation Nr 136 Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik Amtliche Veröffentlichung Jahrgang 1927 Neue Folge Band 64 Pp xxii+A42+B56+C44+D8. (Wien Gerold und Komp)

Diary of Societies

FRIDAY, JANUARY 23

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. W. Tudor Thomas: Successful Grafting of the Cornea in Rabbits.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. N. Gresley: High Pressure Locomotives.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Short Papers on Various Aspects of Lighting.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Friary Hotel, Derby), at 6.30.—J. C. Farrant: Modern Grinding.
INSTITUTE OF FUEL (at Institution of Civil Engineers), at 6.30.—Dr. K. Rummel: The Calculation of the Thermal Characteristics of Regenerators (Melchett Lecture).
INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 6.30.—H. M. Hale: Reinforced Construction at Bournemouth Gas Works.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry and University College of Swansea Chemical Society) (at Thomas's Cafe, Swansea), at 7.—Dr. R. Lessing: Recent Improvements in Coal Cleaning.
INSTITUTION OF STRUCTURAL ENGINEERS (at College of Technology, Manchester), at 7.—A. E. Pierce: Structural Engineering in Modern Gas Works.
WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.15.—J. R. Dickie: The Coking Industry and its Development in Relation to the Manufacture of Iron and Steel.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—E. W. Thompson: The Progress and Development of Steam Generators.
INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers' Technical College, Bristol), at 7.30.—M. Morgan: Fatigue of Metals.
ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Prof. E. L. Collis: Recent Views on Pneumokoniosis.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: The Scattering of Light.

SATURDAY, JANUARY 24

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish Art (1): The Van Eycks.

MONDAY, JANUARY 26

INSTITUTE OF ACTUARIES, at 5.—W. Palin Elderton: Valuations in Modern Conditions.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. D. H. Patey: The Pathological Basis for the Treatment of Varicose Veins by Injections and its Bearing on the Problems of Thrombosis.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section), at 6.45.—R. Walles: Windmills and Millwrighting.
INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—I. Murphy and others: Discussion on Reliable Fractional Horse-power Motors for Commercial Purposes.
INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—B. Leggett: The Medical and Surgical Applications of Electricity.
ROYAL SOCIETY OF ARTS, at 8.—Dr. L. C. Martin: Some Modern Developments in Microscopy (Cantor Lectures) (1).
ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Dr. A. A. Osman: The Importance of Sugar in the Diet of the School Child.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—L. S. B. Leakey: The East African Lakes.

TUESDAY, JANUARY 27

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—G. E. W. Humphery: Air Communications in Africa.
ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. J. C. Bramwell: The Prognosis and Treatment of Heart Disease complicating Pregnancy.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. W. T. Walsh: The Art of Illumination (2).
EUGENICS SOCIETY (at Linnean Society), at 5.30.
INSTITUTION OF CIVIL ENGINEERS, at 6.—F. R. Freeman: The Strength of Arc-welded Joints.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—C. S. T. Paul and others: Informal Discussion on The Oil-immersed Circuit Breaker.
INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at College of Technology, Manchester), at 7.—S. G. Brown: Loud-speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus.
ROYAL PHOTOGRAPHIC SOCIETY, at 7.—C. D. Hallam and R. S. Cox: Etching Three-colour Half-tone by means of a Colour Chart.—H. M. Cartwright, A. Haigh, and E. L. Turner: Improvements in Photo-lithography.—Dr. T. Slater Price: Secondary Reactions in Latent Image Formation: Influence of Free Alkali Halide.
QUEKETT MICROSCOPICAL CLUB (at Medical Society of London), at 7.30.—Gossip Meeting.
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—F. W. Rowe: The Selection of Suitable Steels for Gears.

WEDNESDAY, JANUARY 28

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. Paterson Ross: The Treatment of Cerebral Tumours with Radium; with an Account of Experiments made to study the Effects of Radium upon Cerebral Tissue.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section: Joint Meeting) (at Mining Institute, Newcastle-on-Tyne), at 7.15.—B. Reed: Diesel Electric Vehicles for Railway Service.
ROYAL SOCIETY OF ARTS, at 8.30.—Very Rev. Dean Baillie: The Restoration of St. George's Chapel, Windsor Castle.
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Central Technical College, Birmingham).—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).
INSTITUTION OF CHEMICAL ENGINEERS (Graduates and Students Section).—M. L. Nathan: High Temperature Heat Insulation.

THURSDAY, JANUARY 29

DIESEL ENGINE USERS ASSOCIATION (at Abbey House, Westminster), at 3.—Report of Committee on Heavy Oil Engine Working Costs, 1928–29.
ROYAL SOCIETY, at 4.30.—W. Fernando: (a) The Origin of the Mesoderm in the Gastropod *Viviparus* (= *Paludina*), (b) The Origin and Development of the Pericardium and Kidneys in *Ostrea*.—L. A. Harvey: Studies on Echinoderm Oogenesis.—I. *Antedon bifida* (Pennant). II. *Asterias rubens* (Linn.).—J. Young: The Pupillary Mechanism of the Teleostean Fish *Uranoscopus scaber*.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. Dingle: The Nature and Scope of Physical Science (2).
ROYAL SOCIETY OF MEDICINE (Neurology Section), at 5.30.—Sir Charles Sherrington: Quantitative Management of Contraction for Lowest-level Co-ordination (Hughlings Jackson Lecture).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—A. Lippisch: Development and Construction of Sailplanes and Gliders.
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—R. Waddell: Machining and Working of Stainless Steel.
SOCIETY OF DYERS AND COLOURISTS (West Riding Section).—Dr. S. C. Barker: The Physical Relationships of the Dimensional Characteristics of the Wool Fibre and their Importance in Manufacturing Practice.

FRIDAY, JANUARY 30

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. D. Hunter: Changes in the Bones in Hyperparathyroidism and Hyperthyroidism.
INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Corporation Electricity Showrooms, Swansea), at 6.—J. Urmston: The Electrical High Pressure Testing of Cables and the Localisation of Faults.
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—C. F. Christensen: The Whaling Factory Ship *Vikingen*, with Some Notes on Whaling.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. Fish: Modern Methods of Production of Small Machined Work.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. M. Trevelyan: The First Defence of Gibraltar by the English, Oct. 1704–April 1705.
ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—Col. the Master of Sempill: Gliding and Soaring.
SOCIETY OF DYERS AND COLOURISTS (Scottish Section).—D. K. Colledge: Dyeing for the Scottish Tweed Trade.

SATURDAY, JANUARY 31

MATHEMATICAL ASSOCIATION (at Bedford College for Women), at 3.—Annual Meeting.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish Art (2): Breughel.

PUBLIC LECTURES

SATURDAY, JANUARY 24

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Birds, Past and Present.

MONDAY, JANUARY 26

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—J. C. Dawes: Public Cleansing: The Composition and Storage of House and Trade Refuse.
KING'S COLLEGE, LONDON, at 5.30.—Prof. J. Barcroft: The Constancy of the Internal Environment: its Evolution and Purpose. (Succeeding Lectures on Feb. 2 and 9.)

TUESDAY, JANUARY 27

LONDON SCHOOL OF ECONOMICS, at 5.—Dr. F. A. Hayek: Prices and Production. (Succeeding Lectures on Jan. 28, 29, and 30.)
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. P. P. Ewald: The Theory of Interference of X-Rays as a Domain of General Crystal Optics. (Succeeding Lectures on Jan. 29 and 30.)

WEDNESDAY, JANUARY 28

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—J. C. Dawes: Public Cleansing: The Collection of House and Trade Refuse.
KING'S COLLEGE, LONDON, at 5.30.—Prof. A. Pastor: The Great Age of Discovery (2): The Renaissance in Spain and Portugal.
BELFAST MUSEUM AND ART GALLERY, at 8.—C. E. White: Josiah Wedgwood and what the World owes to him.

THURSDAY, JANUARY 29

BEDFORD COLLEGE, at 5.15.—Sir Philip Hartog: Problems of Modern India (1): Education.

SATURDAY, JANUARY 31

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Most Ancient Egypt.

SATURDAY, JANUARY 31, 1931

CONTENTS.

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The Worth of Education

THE presidential address delivered on Dec 31 last by Sir Richard Gregory at the nineteenth annual Conference of Educational Associations was entitled "The Worth of Science" Proverbial philosophy warns us of the difficulty—even the impossibility—of getting a quart into a pint pot, otherwise the president might have been able to include a few remarks on the kindred subject, "The Worth of Education" This subject is controversial, especially if discussed in relation to the Education Bill now before Parliament for raising the age for compulsory education to fifteen, and Sir Richard Gregory may have preferred the primrose path of peace and order, or he may have foreseen, warned again by proverbial philosophy, that others, including the present writer, would rush in where angels fear to tread

From this point of view the intervention of Sir Ernest Benn on the following day, addressing the Independent Schools' Association, was *ben trovato* As a business man, he has for some time sounded a booming note like Big Ben into our economic darkness May it continue until the dawn of a new economic day! Why, he asked, did it cost £4 a year before the War to give a child elementary education and £13 to day? In his opinion, there was no public demand for the School Attendance Bill It was a "Bill to educate the child to put the father out of work" The officials of the Board of Education, he supposed, exercised their wits by settling questions which arose among themselves There may be some truth in this, for those who wish to study the question of "The Worth of Education" in the dry light of science must be impressed by the lack of evidence on the subject The student of our elementary education in Victorian times reads and digests Matthew Arnold's "Reports on Elementary Schools, 1852–1882", written, as his editor says, in a simple and telling style with so much knowledge of our own and foreign systems, with so sweet a reasonableness, and with so high authority as an expert But he will look in vain for corresponding official reports to-day

We are all educationists nowadays As Charles Hargrove says, teaching is the most difficult job in the world, but "every parent, teacher, elder brother or sister, trained or untrained, themselves ill taught, impatient, dogmatic, stupid, ignorant, and unsympathetic—all must try, for good or ill" There is certainly a need for guidance and we

should be grateful if the officials of the Board would suspend for the time being their discussion of the questions which arise among themselves in order to give the public trustworthy information about the condition of the schools of England. For, failing such evidence, the public may draw conclusions, possibly wrong ones, from unofficial publications, such as Ethel Mannin's "Confessions and Impressions", a book written by an original author who in happier circumstances might have become President of the Board of Education.

Ethel Mannin and Sir Charles Trevelyan, the President of the Board of Education, have this in common—that neither profited much from school education, though we are not disposed to accept *au pied de la lettre* Sir Charles's denunciation of his old school, Harrow, with its distinguished roll of old boys. Ethel Mannin tells us that during the War she was a pupil at a public elementary school and was told to write an essay on patriotism, a suitable subject. Having heard her father quote Dr. Johnson's dictum, "Patriotism is the last refuge of the scoundrel", she naturally worked it into her essay. For this piece of flagrant subversiveness she "was called up before the head mistress, lectured on the wickedness and stupidity of my attitude, and caused to kneel for a whole morning in the school hall, a punishment popular in the school". Her spirit was not broken. She failed, however, to obtain a secondary school scholarship, collapsing miserably in the viva voce examination! The examiners thought her stupid, but as she observes: "I knew I was not stupid, but only that I had not their kind of non-stupidness". Wise child!

'Expert' is no doubt a much-abused word. Mr. Henry Ford tells us that so soon as a man calls himself an expert, he bundles him out of his works. Ethel Mannin would not claim the proud title of educational expert, but her evidence seems to be very much *ad rem*, pointing as it does to the need for improving our existing elementary education before extending its scope. The most remarkable thing about the discussion of the present Education Bill is that the opinions expressed on its fundamental principles have been, with few exceptions, unfavourable. The Bishop of Gloucester stresses this point in his letter to the *Times* of Jan. 10. "I do not suppose", he writes, "that any educational reform of the magnitude implied by the proposed Hadow schools has ever been introduced with less authority behind it. It has really nothing to support it except a Departmental Committee and a good Press", and later, in the same letter: "It is obvious that the proposal to raise the age of compulsory attendance at schools meets with only a limited approval".

In a short article it is not possible to summarise the views which have been expressed on this question, but readers of NATURE will respect the opinion of Sir William Pope, as given in his Norman Lockyer lecture to the British Science Guild. "There is little to indicate", he said, "that a rationalisation of our educational methods is in progress. Those who have to deal much with the young, realise that many, from all classes of society, are so poorly endowed mentally that all but the rudiments of education are wasted on them. Others, again drawn from every stratum of society, are intellectually so gifted that their education may be profitably extended until well into the twenties." No one will suspect this distinguished chemist of a desire to create 'wage slaves'.

Manual work is sometimes the best method of developing human personality. "I don't like work—no man does", says one of Conrad's characters, "but I like what is in work—the chance to find oneself—your own reality—for yourself, not for others—what no other man ever knew." Regimentation, however distasteful to the English people, is necessary to secure that all children learn to read and write and to do sums, though, as regards the last accomplishment, many of the wise and eminent pass through life by using their fingers, Nature's abacus. But the shades of the prison house should begin to lighten before the growing boy as soon as he has acquired these rudiments of knowledge. Part-time education, Mr. Fisher's golden calf, before which the whole educational world prostrated itself a few years ago, is now cast down—unfortunately, we think, particularly as regards works' schools.

What is most to be regretted, however, is the lack of common sense shown in the discussion of these vital questions. Sir Ernest Benn (*loc. cit.*) said that in 1830 very little common sense in regard to education was to be found. We will show our possession of this rare commodity by bringing this article to a close before it becomes discursive—and how better than by reproducing Sir Richard Gregory's quotation in his address on "The Worth of Science" from Descartes, who said that he studied science "to learn how to distinguish truth from falsehood, in order to be clear about my actions and to walk surefootedly in this life".

T. Ll. H.

Geometry of Four Dimensions.

Geometry of Four Dimensions By Prof A R Forsyth Vol 1 Pp. xxix + 468 Vol 2 Pp xi + 520 (Cambridge At the University Press, 1930) 75s net

THIS work, which is primarily a formal treatise on the differential geometry of curves, surfaces, and threefold regions in ordinary homaloidal space of four dimensions, follows fairly closely on the lines of the author's very well known treatise on differential geometry in a three-dimensional space Prof Forsyth naturally prefers, however, in a treatise of this kind, not to assume, on the part of the reader, any previous knowledge of the elementary metrical properties of lines, planes, and planar threefolds in four dimensions, and he devotes the first half of his first volume, therefore, to a very systematic investigation of such properties, partly as a foundation to the subsequent theory, and partly for their own sake This section of his work includes, therefore, a consideration of such concepts as the four direction cosines of a line and the six orientation co ordinates of a plane, leading up to a very complete set of formulæ for the inclination and other properties of lines, planes, and threefolds in four dimensions, and though some readers will probably claim that part of this work could have been simplified by making use of the projective aspect of metrical four space, and in particular by introducing the concepts of solid at infinity and absolute quadric, yet no one will deny that the author's treatment is very clear and adequate as it stands He concludes this more elementary work by a chapter on what he calls *globular* representation of directions, analogous to spherical representation in ordinary space, and uses this in the analysis of general finite or infinitesimal displacements of the orthogonal frame of reference

The remainder of the first volume is taken up with the foundations of the differential theory of curves and surfaces in four dimensions, the analysis involved being very analogous to that in Prof Forsyth's former treatise referred to already He proceeds in particular to establish the properties of a curve at a point of itself, namely, the natural orthogonal frame of reference at the point, the curvature, torsion, and tilt of the curve, and the centres and radii of circular, spherical, and globular curvature He investigates also the curves, analogous to the helix in ordinary space, which have constant curvature, torsion, and tilt, and also those for which the ratios only of these are constant In Chapter ix he considers the dual aspect of a curve as the edge of regression of a developable generated by the intersection of consecutive solids of a simply infinite family, and further on, he interprets the various developables associated with a curve , and finally, in Chapter xi he finishes off his work on curves by outlining briefly the general theory of a curve in any number of dimensions

The chapters on surfaces which occupy the remainder of vol 1 provide a most fascinating investigation, presented with delightful clarity and skill of exposition It appears that a surface in four dimensions is a much more interesting construct in some ways than one in three dimensions It has, for example, at any point O of itself, a normal or orthogonal plane N instead of a unique normal line as in three dimensions, and it appears on one hand that the intersections with N of the normal planes at points consecutive to O lie on a conic in N called by Kommerell the *characteristic conic* of the point O, while on the other hand, the centres of circular curvature at O of geodesics through O lie on a lemniscate in N which is in fact the pedal of the conic in regard to O Not only so, however, for it appears in addition that there are four principal radii of circular curvature of geodesics through O, and these turn out very nicely to be the four normals from O to the characteristic conic, while the feet of the normals, which incidentally are points of contact of the conic and the lemniscate, are the centres of curvature on the four radii in question Prof Forsyth has certainly succeeded in giving a fine account of this fascinating theory

In the second volume the author begins by laying the foundations of the theory of curved three dimensional regions in space of four dimensions He defines such a region by giving expressions for the co ordinates in terms of three parameters, and after obtaining the fundamental quadratic differential form for an arc element on the region, he places on record all the necessary relations between the various associated magnitudes, including expressions for the parameter derivatives of the coefficients of the fundamental quadratic form in terms of Christoffel index symbols, formulæ expressing those of these latter which belong to one kind in terms of those of the other kind, and formulæ for the fifty-four derivatives of Christoffel symbols of the second kind, obtaining finally the complete set of six Gauss and eight Codazzi relations between the coefficients of the fundamental and secondary quadratic differential forms Proceeding then to extend to a region the various notions already familiar in regard to a surface, he gives one chapter on linear curvature and lines of

curvature on a region, another on properties of geodesics and geodesic polar co-ordinates, a third and most interesting chapter on geodesic surfaces and the two measures of superficial curvature, the Riemann and the additive, associated with any orientation of a tangent plane at a point of the region, together with an investigation of their principal values, and he adds a fourth chapter on properties of loci of centres of curvature

In treating next of general properties of surfaces in a region as distinct from those of a surface in free homaloidal four-space, he is careful to point out the important properties of *immersion* possessed by the former relative to the regions in which they lie, as, for example, the measure of deviation of their geodesics from the geodesics of the region He obtains, however, all their spatial properties and curvatures as well, relating these wherever possible to properties of the region

After an illustrative chapter on ovoidal or quadric regions, the author gives next an introduction to the theory of minimal surfaces in four dimensions, first in regard to surfaces of minimal area existing in free space, and secondly in regard to surfaces whose area is minimal on a region contained in such a space These latter are, of course, of great importance as being the most obvious generalisations of the all-important geodesic curves, and Prof Forsyth obtains their characteristic property, namely, that their additive measure of regional geodesic curvature is zero Nevertheless, one feels inclined to think that these surfaces might surely be made to play a more important part than they seem to at present Prof Forsyth, however, evidently finds a more stimulating topic in his succeeding work on minimal regions

In Chapter xxiv the author sketches the theory of the various curvatures, linear, superficial, regional, etc, of a manifold of n dimensions in space of $n+1$ dimensions, obtaining also their principal values at a point He obtains finally, without reference to the absolute differential calculus, the principal values of all the curvatures at a point in terms only of those of the linear curvatures there One curious fact which emerges here is that although for surfaces in ordinary space the coefficients of the secondary quadratic form are not usually expressible in terms of those of the fundamental quadratic form, yet for a manifold of n dimensions in $(n+1)$ space $(n \geqslant 3)$, the corresponding coefficients are in general so expressible—a most interesting result

The rest of the work is taken up with a systematic investigation and geometrical interpretation of the concomitants of configurations in quadruple space For this purpose, Prof Forsyth uses by preference Lie's theory of continuous groups, which he believes to have certain definite advantages in this connexion over the method of the absolute differential calculus He considers in successive chapters concomitants of curves, surfaces, and threefolds, and includes in the last chapter complete systems of concomitants of a region, of grades three and four, in terms of which all others of the same or lower grade can be expressed J G S

Concerning Ceramics.

(1) *An Encyclopædia of the Ceramic Industries being a Guide to the Materials, Methods of Manufacture, Means of Recognition, and Testing the various Articles produced in the Clayworking and Allied Industries* By Alfred B Searle In 3 volumes Vol 1 Pp xxvii + 391 Vol 2 Pp 462 Vol 3 Pp 384 (London Ernest Benn, Ltd, 1930) 63*s* net each volume

(2) *Diatomaceous Earth* By Robert Calvert (American Chemical Society Monograph Series, No 52) Pp 251 (New York The Chemical Catalog Co, Inc, 1930) 5 dollars

(3) *Some Writers on Lime and Cement from Cato to Present Time* By Charles Spackman Pp xvii + 287 (Cambridge W Heffer and Sons, Ltd, London Simpkin Marshall, Ltd, 1929) 15*s* net

(1) IN attempting to arrive at an estimate of the utility of this complex work—Searle's "Encyclopædia"—the reviewer first commenced to trace out the ramifications of various subjects, but the constant distractions provided by interesting notes on totally different matters made progress slow and uncertain This method was then discontinued in favour of a system of 'dipping' on single topics, some of which were very familiar to the reader and some the reverse Continuing this method for a few months rather drastically altered his first impressions It is not difficult to find a variety of mistakes, and by these to frame a condemnation of the work What is more difficult is to view the work fairly from the point of vantage of the normal user, that is, one frankly seeking information

The book is full of pleasant surprises, on the other hand, much is omitted which one might fairly expect to find The author largely forestalls criticism of his imperfections by suggesting that the work, to be done perfectly, could not be accomplished by any man, and that, with all its imperfections, it might still be very useful, and so it is.

Its primary appeal, properly enough, is to those who have, so far, not had much contact with the object of their inquiry Nevertheless, there is an imposing array of articles of a very high standard Examples are the articles on electrical insulators and porcelain, hardness (of ceramic materials), plasticity, roofing tiles, rope haulage, and semi-dry process A very valuable feature of the book is the inclusion of fairly extensive references to the literature In this respect, if no other, the research worker and technical man, engaged in the task of collecting information on a new venture, are sure to be well repaid by including this book as a means of ready access

Although the work is, on the whole, well balanced, the reviewer feels that there is less vitality and intimate appreciation shown in the articles relating to pottery practice than in the other numerous, and chiefly 'heavy claywares', branches Information relating to kilns and ovens for fine ceramic goods seems disproportionately small, though this can be compensated by use of the references In this connexion, a misrepresentation of accepted theory is to be found in the article on continuous chamber kilns, where it is stated that "A further disadvantage is that hot air must pass downwards through the chambers to be heated, this is in the opposite direction to its natural flow, so that it is difficult to ensure the heat being uniformly distributed" The article on "Output of Kilns" might have been expected to give typical figures for different kilns and products, whereas the information afforded is limited to the acceleration of brick kilns and general remarks about chimneys, foundations, leakage, and wet fuel

The article on drying, though founded on the excellent treatment by Bourry, has a rather antique aspect for a modern work and would have been improved by the infusion of ideas from, for example, the work of Fisher and of Sherwood The author bravely copes with the causes of defects in drying, but seems to explain them in terms which leave the reader no wiser He refers to the importance of a knowledge of the ratio of the rate of evaporation to the rate of diffusion of water in the body, and that this ratio must be found for different materials, and *shapes*, by trial, before such defects can be cured Now, a ratio, being a number, needs an instrument, or instruments, for its measurement One never hears of such being used in practice, and, in fact, such problems are solved, on the works, by hit-and-miss methods Furthermore, it is certain that the diffusion of moisture in clay becomes more and more difficult as its shrinkage progresses, and a piece of clayware, particularly if thick, has a moisture gradient, with corresponding variations of resistance, from the inside out to the face The state of affairs is such that the ratio must be different for every part of the article and every interval of time during the course of the drying

In dealing with the high temperature side of ceramics, a large number of phase diagrams is reproduced Many of these are well placed, but some appear to be purely ornamental, as no reference is made to them, or explanation of the marked points, in the text Future editions will, no doubt, amend this

The article on barium carbonate should distinguish between the relative utility, as a cure for troubles due to soluble sulphates, of the precipitated substance and of ground witherite

In dealing with daub for kiln wickets, etc, a better statement should have been given of the making of a suitable mixture, sufficiently adherent, and, above all, free from such shrinkage as gives rise to cracks on drying

The question of filtration of ceramic body slips is one of very great importance, and whilst many aspects are well treated, it is regretted that due emphasis is not placed on the fact that clay filters itself, the filter cloth being merely a support, and that, being to some extent colloidal, the pressure of filtration has much to do with the ultimate residue of water in the cake, apart from its effects on the speed of working

The reviewer would like to put forward a plea for that important clay working area, North Staffordshire, in the matter of the use of the term marl It is the custom of that district to refer to the local fireclays as 'marl', without any suggestion that they are inferior in refractoriness due to the presence of lime, which they are not The confusion which arises is one which could readily be cleared up in a work of this nature

Among definitions which will prove misleading to the student, though clearly not intentional, are "Kation—One of a pair of electrodes", and, under "Quartz", "angular rotation in degrees per min" There is a number of other mistakes, doubtful statements, and cases of bad construction in this article They appear sporadically in a work which is, on the whole, well edited The article on plasticity, in spite of its general good quality, suffers in this way The thickness of the water layer on clay particles in a plastic mass is given as 1 00005 in, alumina- for alumino-, W E Emery for W E Emley, Emerly for Emery, and Jachum for Jochum

The tables giving the composition of seger cones are in need of editorial attention

The reader of this rather fearsome sample of objections and errors might be influenced to avoid the book That would not be the reviewer's wish, considering the very wide scope of the work, its undoubted helpfulness for ready reference, and the considerable opportunities afforded by the literature references of eliminating errors by closer inquiry Mr Searle is certainly to be congratulated He has greatly lessened the labour for those who may follow in his footsteps, and, in the meantime, provided a useful guide for busy men

(2) Calvert's "Diatomaceous Earth" is a very worthy addition to the American Chemical Society's Monograph Series, which already includes books of the greatest interest to the ceramic technologist Amongst these may be mentioned Sosman's 'Properties of Silica", Svedberg's "Colloid Chemistry", and Vail's Soluble Silicates in Industry" The use of diatomaceous earth, or kieselguhr, for high temperature insulation has very greatly increased in the last decade, and no better subject for a monograph, collecting existing information in a useful form, could have been chosen The same remark applies, with equal if not greater force, with reference to its use as an aid to filtration, notably of sugar syrups, and as an addition to Portland cement Whilst these are the chief uses of kieselguhr, it has many others depending on its fine pore structure, polishing powers, and reactivity with lime and alkalis

Calvert deals with the natural origins, properties, and uses of his material in a manner which leaves little to be desired The illustrations and references are copious and well chosen, ready reference is facilitated by good indexes The paper and binding are of good quality Very few adverse criticisms seem possible a few cases of faulty construction and printers' errors occur For those who prefer to think of furnace temperatures in terms of Centigrade degrees, the almost invariable use of the Fahrenheit scale involves frequent mental arithmetic The importance of the Danish deposits has not, perhaps, received its due, but as the development in this area has been chiefly recent in date, it will perhaps receive more attention in a future edition The work undoubtedly deserves a special place on the bookshelves of every ceramic technologist

(3) All those who have cause to search the literature for historical information on calcareous cements and lime will be grateful to Charles Spackman for collecting the results of his researches in this volume The work commences with short definitions of a large variety of cements, and an index to the names of the authors whose works are dealt with chronologically in the main body of the book The works abstracted or described range from Marcus Porcius Cato, 234–149 B C, to the modern works of Knibbs and Eckel and the publications of the Building Research Board The reviewer has noted a few minor errors, but, on the whole, the book has been well edited It concludes with a suitable subject index S R HIND

A Late Greek Manuscript on Alchemy

Union Académique Internationale Catalogue des manuscrits alchimiques grecs Publié sous la direction de J Bidez, F Cumont, A Delatte, Sir Frederic Kenyon, O Lagercrantz, J Ruska et C O Zuretti Tome 7 Anonymi de arte metallica seu de metallorum conversione in aurum et argentum Edidit C O Zuretti Pp lx + 466 (Bruxelles Maurice Lamertin, 1930)

THE earliest treatises on chemistry were composed in Hellenistic Egypt (Alexandria) during the first centuries of the Christian era. Their language was Greek (κοινή), and their continuations in the Byzantine period, for example, under Heraclius (A D 610–641), present no new features After the Mohammedan conquest of Egypt in A D 640, the treatises passed into an Arabic dress, and from about A D 1100 they arrived, in a sadly corrupted form, in the west in the shape of Latin versions (or 'perversions') made in Spain The original Alexandrian treatises have been published, with translations, by Berthelot and Ruelle ('Collection des alchimistes grecs", 3 vols, Paris, 1887–88), and, although from time to time threats of an 'improved' edition have been put forward rather fretfully by German scholars, this publication is likely to remain for some time to come the basis of our knowledge of the earliest chemistry The principal manuscripts and their contents have been known for a long time, in the selection of texts for publication or republication the advice of a chemist would no doubt prove useful, since the interest and value of such texts vary considerably

That the Latin versions were sometimes retranslated into modern Greek was well known Berthelot ("La Chimie au moyen âge", vol 1, p 155, *ib*, "Introduction à la chimie des anciens et du moyen âge", p 207) had directed attention to a case in point, the work "Πέτρου τοῦ Θεοκτονίκου

πρὸς τὴν τέχνην τῆς ἀρχημίας", which is merely a translation of a Latin work attributed to Albertus Magnus Some of the "Traités techniques" published by Berthelot ("Collection", 321 f) also appear to be of this character

The work edited by M Zuretti, with great care and skill, which is now before us, appears to be a translation made about the fourteenth century in Italy from a Latin treatise or treatises, probably in turn translated from Arabic sources The date and language of the treatise will be sufficiently obvious from the small chrestomathy which follows

ελέξιρ	*μποτον μπαρβοτον*
ἐν φουρνέλου,	*τὸ ατιγκὰρ εν ἔλαιον ιεροισολιμιτικὸν*,
ἐν ὕδατι καυστικῷ,	*εν ὀθονίῳ πικνῷ*;
αλὸς νίτρου καὶ βοραχίου,	*ἐν φιάλῃ* (for a flask)
ἐπὶ νάφθαν,	*ρὸτουλον αρσενικὸν*,
βάλε εις ουρινάλιον,	*ὕδωρ ζωῆς* (*aqua vitae*),
αλὸς αμμωνιακου,	*ἅλας ἀλκαλὶ καλουμένης σόζα* (*soda*),
εν σιέλῳ (*axungia*),	*ἅλας της πέτρας* (*sal petrae*)
ἄλας βίτρουμ	*ἅλατος τοῦ ταρταρου*

The theory of the composition of metals from mercury and sulphur, which is attributed to Hermes Trismegistus, is given in the usual form the four 'spirits' (that is, volatile bodies, a designation which appears in the Alexandrian treatises) are mercury, sulphur, arsenic, and sal ammoniac, although the latter is said to be really a salt, not a spirit The word *xerion*, which usually means simply 'powder' (*λείωσον εἰς ξηρίοι*), is, for some reason, not translated by the editor An unusual feature is the classification of some metals as 'masculine' (for example, iron), which may have an astrological basis

The only actual authority quoted in the text appears to be "Solomon the soldier" (*κατα τον Σολομῶντα τὸν στρατιώτην*), although Arnold of Villanova appears in the table of contents Sublimation is *ἀνάβασις* the Alexandrian term is *ἄρσις* Some of the recipes have the ending characteristic of a Byzantine treatise *σὺν θεῷ* (Stephanos in Ideler's "Physici et medici Graeci minores" vol 2, pp 199-253, each chapter, *πρᾶξις*, title, of which has it) There is an attempt at a lexicon of concealed names (p 174), and no doubt many of the names of substances in the recipes are of this character, since the chemical operations as given are frequently impossible A very curious name is *ἅλας τὸ ἀλαμπρὸτ* (*sal alembroth*, used, according to Kopp, "Geschichte", vol 4, p 195, for a mercury salt by Paracelsus "or perhaps earlier in our treatise it is a mixture of alkali salts) Mineral acids (*ὕδωρ δε χαλκάνθου*) appear, as well as rectified alcohol

Several words are left untranslated by the editor (1) *κηρον νεοὺμ τίμιοι* (p 216), given as *ceronneum pretiosum* (? "precious ointment", as *μύρον βαρυτιμον* in Matthew xxvi 7), the translation on p 217 seems defective in some respects, *ceration* is an operation described in the early Alexandrian treatises and is derived from the old encaustic painting in four colours black, white, yellow, red, in wax, these colours being mixed on the palette, *κηροτακις*, over a small brazier (shown in Berthelot's, "Introduction", p 146 but there erroneously called a 'bain marie"), (2) *τζηρικι* (probably related to *ξηριοι*), (3) *σαρειπινουμ* (indexed as ? franco gallice *sapin* ? ', which is improbable *serapinus* is gum arabic in Ruhland's 'Lexicon", 1612, p 432), (4) *μαστιχιον*, which dissolves iron and all bodies and is *μυστηριον θαυμαστόν*, perhaps an acid distilled in the alembic (instrument de verre, en forme de *μαστταριοι*," in Synesios, Berthelot, 'Introduction , p 164) (5) *οκοι* (p 320, perhaps *ὦχροι*, as it is among yellow and red colours) (5) *ινδαικοι* (? *ondanique* Chinese iron), etc

The mention of a reverberatory furnace (*φουρνελλιοι ῥεβερμπερατιονις* p 262, etc) seems an early reference reverberatory fire (*πῦρ ῥεβερμπερατιζόνις*, p 308) is also used The use of the reverberatory furnace in England is said by Bishop Watson ('Chemical Essays", vol 1, p 33, vol 3, p 273, where it is called a *cupola*) to date only from the end of the seventeenth century

The Latin translation appears to be technically fairly good (*θειοι* translated as *aes* on p 383 has escaped the list of corrigenda on p 465), the requirements of chemists would better be met by French or English The chemical interest of the treatise is small, most of the recipes given seem to have been copied unintelligently by the compiler of the manuscript, which appears to contain material of very various dates Some parts are derived from Alexandrian or early Byzantine material, others have certainly come from Arabic versions, whilst others seem quite late and are probably derived from Italian recipe books almost contemporary with the date of compilation of the MS It is perhaps noteworthy that the treatment of pigments finds no place in the treatise, whilst it occupies most of the space in Italian recipe books of the same or somewhat later period

We have to thank M Zuretti for the very successful result of his difficult task of editing this interesting work and for the excellent index which accompanies it

J R PARTINGTON

Our Bookshelf.

Allen's Commercial Organic Analysis Vol 8 *Glucosides, Non Glucosidal Bitter Principles, Enzymes, Putrefaction Bases, Animal Bases, Animal Acids, the Cyanogen Compounds, the Proteins, the Digestion Products of Proteins* By the Editor and the following Contributors Julius Grant, G Barger, K G Falk, Philip B Hawk and O Bergeim, G H Buchanan, S B Schryver and H W Buston Editor Dr C Ainsworth Mitchell Fifth edition, revised and partly rewritten Pp x + 761 (London J and A Churchill, 1930) 30*s*

NEARLY twenty years have elapsed since the issue of the corresponding volume in the fourth edition of "Allen's Commercial Organic Analysis" Probably in no field of analytical work have more changes taken place during this period than in the subject matter under review, and particularly in the sections on nitrogenous constituents of animal and plant materials The present volume is, therefore, practically a new book The general subject is considered in a series of well written monographs by specialists in their respective subjects, and the high standard of the previous volumes has been maintained

As pointed out by the editor, there must of necessity be a certain amount of overlapping in an exhaustive work of this type written by a large number of experts Thus, enzymes are considered in their relation to glucosides and elsewhere in the book from a different aspect, namely, in their connexion with the hydrolytic dissociation of proteins On the whole, however, the book gains by such repetition, since the subject matter is considered by each specialist from a different aspect Again, in a consideration of the subject matter of 'animal bases' certain related compounds have been discussed already in previous volumes (pyridine derivatives, mononamines, etc), while some related compounds are reviewed in the section on 'putrefaction bases' In this section, therefore, the author has been able to omit these from his review Even with these omissions this section on 'animal bases' extends to more than 180 pages, and constitutes a very complete thesis in itself, on this difficult subject The sections in the present volume on the analysis of proteins and on the digestive products of the proteins are the last contributions of the late Dr S B Schryver to this branch of chemistry It is of interest to note that it is intended to include a tenth volume in this series which will include recent advances and also a complete index to the whole series

J REILLY

Gestalt Psychology By Prof Dr Wolfgang Köhler Pp xi + 312 (London G Bell and Sons, Ltd, 1930) 15*s* net

THE author in his preface apologises for his difficulty in presenting *Gestalt* psychology in a foreign language, one may say at the outset that his English is much better than that of many writers to whom it is the mother-tongue The author also points out that the subject matter as presented resembles a promising start rather than a complete achievement It is a pity that this useful point of view is not maintained as the tone of the actual exposition, for that appears to be rather unnecessarily controversial and dogmatic

To express the *Gestalt* theory in a few words is impossible It arose primarily out of the experimental study of space perception, and the results of this study led to dissatisfaction with the prevailing theories and the formulation of what is known as the *Gestalt* theory The word *Gestalt* has too much significance, unfortunately, in the German language, and its English equivalent too little It is used to mean 'form' or 'shape', but also a state or process, or a segregated whole, and the theory is applied to most of the phenomena of sense perception, and then to processes of thought The author discusses the properties of organised wholes, behaviour, association, reproduction, and insight, from this point of view The varieties of directed attitude are held to be due, not to instincts or pre existing drives, but to the actual situation In experimentation the Gestaltists have done excellent work, and their challenge has been a useful stimulus, but a book of this size ought not to omit such contemporary work as that of Prof Spearman

The hypotheses put forward involve both physiology and physics, and the truth cannot be estimated yet "All experienced order in space and time is a true representation of a corresponding order in the underlying dynamical context of physiological process" We do not know Although there are constant references to the experimental data, yet few details are here given Less repetition and fewer analogies from physics would have added considerably to the value of this nevertheless important communication

The Aquatic (Naiad) Stage of the British Dragonflies (Paraneuroptera) By William John Lucas (Ray Society Volume No 117, for the Year 1930) Pp xii + 132 + 35 plates (London Dulau and Co, Ltd, 1930) 25*s*

IN this work the author describes and figures the last immature instar in each of the forty-two species of dragonflies found in Great Britain Since the whole of the early life of these insects is passed in water, and lasts on an average about two years, it is not surprising that the complete biology of very few of the species has been followed There is consequently a large field open for the enthusiastic naturalist to explore as regards these insects In the introduction to this volume the general structural details of the immature stages of dragonflies are explained, and with this information the reader is enabled to pass on to the diagnostic keys to the nymphs or naiads, as they are variously termed, arranged in families, genera, and species The use of these keys will enable any given example to be traced down, and this preliminary determination can then be confirmed by reference to the detailed specific descriptions given in the general text

At the end of the book there is a wealth of coloured and half-tone plates, which are reproduced in all cases from the author's personal drawings In these plates the entire nymph, or naiad, is accurately figured, together with the mentum and palpi In the suborder Zygoptera one of the caudal lamellæ is usually also represented A monograph so complete as the present one is obviously the result of many years' patient search and observation In some cases the living stages have been procured and the descriptions and illustrations made from these, in others, spirit material has been utilised, while for a considerable number, recourse had to be made to the exuviæ out of which the imagines had emerged The author has appended to his descriptions notes relative to the habits, etc, of the different species Although all the species are carnivorous, little seems to be known relative to their actual prey and whether they exercise much discrimination in this respect

The present volume is well up to the standard of other volumes issued by the Ray Society, and both that body and the author are to be congratulated upon its production A D I

The Newcomen Society for the Study of the History of Engineering and Technology Transactions, Vol 8, 1927–1928 Pp xi + 196 + 23 plates (London The Newcomen Society, 1929) 20*s*

VOL 8 of the *Transactions* of the Newcomen Society contains ten papers read during the winter 1927–28 and during the summer meeting of the latter year at Stourbridge, two notes and communications, a subject list of books and pamphlets relating to the history of technology, 1926–30, a list of members, the annual report, and 23 finely produced plates As usual, the range of subjects is a wide one, the papers including those of Mr E W Anderson on the development of the organ, of Mr T Rowatt on railway brakes, of Mr J E Hodgson on James Sadler of Oxford, and of Mr J W Hall on the making and rolling of iron

Two papers respectively by Engr Capt E C Smith and Mr L F Loree deal with the early history of steam navigation in England and America In that by the former is an account of the machinery of the s s *Victory* in which Capt John Ross set out in 1829 to discover the North west Passage From Ross's account of his long sojourn in the north, it was known that the machinery proved a failure, but hitherto nothing was known of its construction Particulars and sketches of it were found a year or two ago in the note-books of Simon Goodrich which were preserved in the Science Museum, and some of his sketches have been reproduced in the *Transactions*

The summer meeting gave an opportunity for several interesting communications on the early industries of the Stourbridge district One of the 'notes' included in the volume is a long and valuable paper by Col N T Belaiew on the Sumerian mina, its origin and probable value, while another by Dr Carl Sahlin recalls the work of Thomas Lewis and Samuel Owen, two British pioneers of mechanical engineering in Sweden

Myths and Legends of the Australian Aboriginals By Dr W Ramsay Smith Pp 356 + 38 plates (London, Bombay and Sydney George G Harrap and Co, Ltd, 1930) 21*s* net

DR RAMSAY SMITH classifies the myths and legends of the Australian aborigines which he has collected in this volume into 'origins', that is, stories of the creation and beginnings of things, animal myths, religious, social, and personal myths, and has strung them together in the form of a connected narrative by notes on customs and beliefs cognate to each class These notes give the uninstructed reader a general view of aboriginal culture as a background for the stories Dr Ramsay Smith is fully alive to the importance of aboriginal legendary lore in its bearing upon their institutions, and it is therefore surprising to find that, even though he disclaims any intention of giving a scientific exposition of Australian mythology, there is no indication of where and when the material was collected Except in one or two cases, the name of the tribe in which the myth occurred is not mentioned All that we are told is that the myths refer to "only a few localities in Australia and only a few tribes in them" As the stories, which are very much 'written up', bear very directly upon problems of aboriginal belief, this is a grave defect —all the more, perhaps because the book is intended to be popular

La Lorraine metallurgique Par Axel Somme Pp viii + 250 + 7 planches + 12 cartes (Paris Éditions Berger Levrault, 1930) 30 francs

IN spite of their low iron content, the minette deposits of Lorraine are of great importance Before the European War they were partly in Germany now they lie in France except for a small area in Luxemburg, which will probably be exhausted in half a century Prof Somme has made a close study of the geographical and economic conditions in these relatively new iron ore districts with their rapidly growing towns He has produced a monograph of considerable value, tracing the growth of the industry, its lessening dependence on Ruhr coke its markets and lines of export, and the main labour problems which are entailed He discusses even the effect of the industry on agriculture in Lorraine and Luxemburg The book is well documented and has a number of sketch maps and illustrations

Philosophy of a Biologist By Sir Leonard Hill Pp viii + 88 (London Edward Arnold and Co, 1930) 3*s* 6*d* net

THIS little book is a review of our present knowledge and views by a distinguished physiologist It will be read with pleasure and interest by all scientific men, whether or not they agree with the author's endeavour to suggest that "modern science has brought us to the conception of a power eternal, infinite, unknowable energizing all in the universe, the dead no less than the quick"

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Stellar Structure

IT is only with some qualms that an outsider can enter into the discussion of questions of stellar structure, but I feel that Sir James Jeans is speaking more favourably of Prof. Milne's theory than he thinks when he says that it contains little that has not been anticipated either by Sir Arthur Eddington or by himself.[1] A theory that will combine the good points of Eddington's and Jeans's theories is precisely what observers of the progress of astrophysics have long wished to see. Jeans requires a liquid interior to explain binary fission; Eddington says that owing to ionisation the gas laws must hold through most of the interior. Eddington, assuming that the gas laws hold throughout the interior, infers the mass-luminosity relation, which is verified by observation except for the adjustment of a single constant. Neither theory appears to account for the facts explained by the other, and there must be something that both authors have overlooked. It seems to me that the chief recommendation of Prof. Milne's method of attack is that it foreshadows a means of finding out what this is.

As to Prof. Milne's results, the most striking seems to me to have escaped comment. In his forthcoming paper[2] he gives results for the companion of Sirius, containing an adjustable parameter β. If we take this equal to 0·28 we get

	Theoretical	Observed
Mean density (gm./cm.^{3})	6×10^4	6×10^4
Radius (cm.)	$3{\cdot}4 \times 10^9$	$1{\cdot}9 \times 10^9$
Effective temperature (degrees)	6000	8000–10000

An agreement in order of magnitude for matter so far removed from any state known in the laboratory must be impressive, particularly since, as Prof. Milne indicates, the theory is capable of further development.

The generation of stellar energy has long been an intractable problem. Eddington recognises the difficulty of accounting for it at the temperatures given by his theory. Jeans deals with it by introducing radioactive elements of higher atomic number than uranium. Whether this is an assumption or an inference, mere radioactivity, as usually understood, scarcely seems likely to give so great a secular diminution of mass as the stellar time-scale requires. Mutual annihilation of protons and electrons will do it, but this does not take place in ordinary radioactive processes. The great recommendation of Prof. Milne's theory is that it provides temperatures in the central regions of a star such that this mutual annihilation can be explained without going beyond current physical theories. On the other hand, the amount of generation given still needs quantitative test.

The defect of Milne's and Eddington's theories alike seems to be that they require too high a value of the stellar opacity, as was pointed out by several speakers in the recent discussion at the Royal Astronomical Society. Is it possible that this is because the chief mode of transfer of stellar energy is not by radiation but by vertical convection currents? All existing theories are against this suggestion, yet two circumstances point towards it. The granular appearance of the surface of the sun, as seen in a photograph taken in monochromatic light, strongly resembles that noticed by Bénard[3] and later workers[4] in the surface of a thin layer of liquid that has become unstable under a vertical temperature gradient just exceeding the adiabatic; also that shown in photographs of the upper surface of strato-cumulus clouds. Against this we have the fact that Prof. Milne seems to have shown[5] that the temperature gradient in the photosphere does not reach the adiabatic except possibly inside a sunspot. Secondly, if we *demand* a temperature of the order of 10^{10} degrees for the generation of subatomic energy, the whole of this generation must be in a small sphere about the centre of the star, and radiation may be unable to dispose of it at a gradient under the adiabatic.

Current theories, by assuming generation throughout the star, must give too low a gradient in the central regions. If this suggestion is correct, vertical currents must be generated, and these will redistribute the heat so as to keep the gradient near the adiabatic for a stream of matter carrying its radiation with it. This has been discussed by Prof. Milne, apparently with adverse results, but I am still inclined to think that his discussion may have constructive and not merely destructive value.

HAROLD JEFFREYS.

St. John's College, Cambridge.

[1] NATURE, Jan. 17, p. 89.
[2] *Mon. Not. Roy. Ast. Soc.*, Nov. 1930.
[3] *Ann. d. Chimie et d. Physique*, 23, 62-144; 1900; also James Thomson, Collected Papers, p. 136.
[4] Cf. A. R. Low, NATURE, 115, 300; 1925.
[5] *Quart. Jour. Math.*, 1, 1-20; 1930.

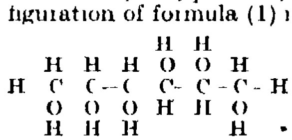
An X-Ray Study of Mannitol

IN NATURE of Jan. 3, p. 11, Miss Thora C. Marwick gives the results of an X-ray examination of mannitol. I have recently completed an investigation of the structure of *d*-mannitol in the Chemistry Department of the University of Edinburgh, and have obtained the following results from the X-ray analysis:

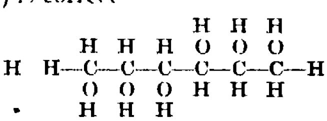
Space group, Q^4; $a = 8{\cdot}66$ A., $b = 16{\cdot}58$ A., $c = 5{\cdot}50$ A.; calculated density, 1·522 gm. per c.c.; 4 molecules per cell.

Groth (*Chem. Kryst.*, vol. 3, p. 431) reports on two crystalline modifications of *d*-mannitol; the β-form which is always obtained by crystallisation from water is the form which was examined.

Irvine and Paterson (*Jour. Chem. Soc.*, 105, p. 898; 1914) have shown that the terminal primary hydroxyl groups of the *d*-mannitol molecule do not appear to possess free rotation, but assume preferentially the fixed positions shown in formula (1). A second possible configuration is shown in formula (2), but a comparison of the reactive powers of the terminal hydroxyl groups made by Irvine and Steele (*Jour. Chem. Soc.*, 107, p. 1221; 1915) proves that the configuration of formula (1) is correct.



(1)



(2)

W. T. Astbury and Miss K. Yardley (*Phil. Trans.*, A, vol. 224, p. 221; 1924) show that in a crystal belonging to the space group Q^4, and having four molecules in the unit cell, the molecules must be asymmetric. Of the two possible configurations shown in formulæ (1) and (2), that of the latter possesses a diad axis of symmetry, while that of the former cannot possess any symmetry. The structure of the molecule of *d*-mannitol within the crystal is therefore represented by formula (1). This structure was also assigned to *d*-mannitol by Irvine and his collaborators examining the substance in solution.

An investigation of the crystal structure of *d*-

mannose is now nearing completion, and the results of the X ray analysis of d mannitol and d mannose are to be incorporated in a paper which is in preparation

GEORGE W. McCREA

University, Edinburgh, Jan. 12.

The Nature of Time

EDDINGTON[1] has argued that the second law of thermodynamics definitely requires a one way flow of time, although all other physical laws are equally valid for $+t$ and $-t$. Lewis[2] has taken the opposite stand, and concluded that entropy entails no temporal implications, hence time must be considered as twofold. Both agree that consideration of an individual particle yields no clue to the dilemma.

Pressing Eddington's 'time's arrow' argument it appears theoretically possible to interconnect all elementary volumes of equal entropy in the universe by hyper surfaces orthogonal to the time lines tangent to 'time's arrow'. Since entropy is a relativity invariant, this would determine a unique lattice for separating space and time, contrary to the principle of relativity.

It has occurred to us that since the only real argument in support of one way time is derived from a consideration of statistical assemblages, it may be that time itself is discrete and should be statistically treated. To our knowledge this possibility has not previously been suggested, although Ives[3] has recently pointed out the intimate association of frequency (and therefore time) with mass and energy, both of which have been found to be discrete.

Pursuing the thought a little further, if the unit of time were intimately connected in some way with the electron or proton, some light might be shed on the mystery of quantum jumps. Since h/mc^2 has the dimensions of time, a possible value for a quantum of time would be 8.12×10^{-21} sec. obtained by substituting the mass of the electron for m in the above expression.

If time is found to be essentially discrete and statistical then, since action and matter are already so accepted, the postulate of discrete or statistical space and electric or magnetic fields would also become highly probable.

F. O. WOLLASTON.
K. W. MILLER.

Commonwealth Edison Company,
Chicago, Illinois, Dec. 20.

[1] "Nature of the Physical World" (Cambridge University Press, 1928).
[2] "Symmetry of Time in Physics" (*Science*, June 6, 1930, p. 569).
[3] "The Growing Importance of Frequency" (NATURE, Mar. 22, 1930, p. 454).

Equipotentiality of the Amphibian Eye Primordia

THE experiments referred to below are concerned with the problem of the regulative power of embryonic *anlage*, the study of which has been taken to prove the equipotentiality of the eye primordia in amphibian embryos in the stages following the closure of the medullary folds. In *Pleurodeles waltli* it has been shown[1] that two optic vesicles may fuse together when that of the donor is transplanted in the close proximity of the optic vesicle of the host, keeping the same orientation of the normal position in the implanted eye. The degree of fusion depends upon the size of the removed portion of the vesicle in the host, and varies from that of double eyes partially fused to single eyes of larger size than the normal which have developed by complete fusion of the two optic vesicles, which regulate its size afterwards, provided that the lens is not double.

By transplanting the optic vesicle of the donor dorsally and ventrally, cranially and caudally, or in the outer portion of the vesicle in the host, it has been possible to show the morphogenetic equipotentiality of the eye primordia. This is further shown by the fact that the anterior, posterior, ventral, dorsal, or medial halves of the vesicle may regulate and give rise to a normal but smaller eye. Such results have been extended by myself in further experiments on *Triton*, *Axolotl*, *Rana esculenta*, later by Detwiler[2] in *Rana fusca*. More recently, in some experiments on lens induction in *Rana catesbiana*, I repeated my own experiments on the fusion with the same results.

The chief results concerning the extent of fusion of two optic primordia in the experiments already described, together with the regenerative power of the optic vesicle or its compensatory regulation, have been dealt with. Our experiments have shown that the easiest way to get complete fusion is to remove a certain amount of the exterior part of the host vesicle, transplanting in its place the vesicle of the donor with the same kind of operation, it has been possible to get the clearest cases of regulation in the medial half of the vesicle. In this way the potentiality of the optic vesicle's constituents has been analysed, controlling each half of the vesicle delimited by the transversal, frontal, and sagittal planes.

It has been found also in my fusion experiments, that there exists a very close relation between the behaviour of the lens and the fused eye. Examples of such are cases in which the lens ectoderm was not transplanted with the optic vesicle and the double eye arose with a normal size lens; cases of transplantation of the optic vesicle with the overlying ectoderm which gave rise to double eyes with double lenses; or cases of a single lens produced by the fusion of two lens primordia. In the first case the regulatory reduction of the size in the double eyes seems to be accelerated, the same occurring in eyes with single fused lens; in the latter case the presence of two lenses causes less regulation of the form and size of the eye, and in some cases this regulation does not occur at all. A point of particular interest which has been investigated more carefully is the reaction of nerve centres to the double eye (resulting from complete fusion of two optic vesicles) in which case the number of nerve fibres growing in the thicker nerve has been increased by the implantation of an additional optic vesicle. There is always a very clear hyperplasia of the central nervous system and the amount of the grey matter in the wall of the mid brain on the side opposite to the double eye increases because of the greater number of the ingrowing nerve fibres.

A similar reaction has been shown for a single eye transplanted in the ear region by May and Detwiler[3] in *Amblystoma*, by May[4] in *Rana temporaria* and *Bufo vulgaris*, but in this new condition established by a double nerve which belongs to a larger sense organ this reaction has a particular significance for its quantitative nature. These effects are closely similar to the hyperplasia found by Burr[5] in *Amblystoma* following the fusion of two nasal pits, and to the hyperplasia described by Twitty[6] when a large *Amblystoma tigrinum* eye is transplanted in its normal position in *A. punctatum* embryos.

In my experiments the size of the larger eye, sometimes double that of the normal and originating by complete fusion of the two eye primordia, the normal and the grafted one, and the consequent disturbance of the number of ganglionic cells in the double retina, causes also a real shifting of the grey matter cells in the brain toward the ingrowth of the supernumerary nerve fibres. My new experiments in *Axolotl*[7] have shown the possibility of such an increase of the amount of the grey matter as a result of the transplantation of a supernumerary single eye in a different region of the head, in other words, with abnormal connexions with the brain in the olfactory

optic and otic region This change of the grey matter occurs also in the brain tissue belonging to the donor which has been involved in the transplantation either in the anterior, middle or posterior brain In any event, the shifting and increasing of cells in the grey matter are always quantitatively greater with a double fused nerve Therefore the affinity between nerve centres and sense organs is shown by a reaction of growth (cell division) which occurs in the region corresponding to the supernumerary sense organ The latter, for that reason, must have a very clear influence on the development of nervous centres

These results are in harmony with the recent investigations of Harrison[8] concerning development and growth of heteroplastically transplanted eyes

P PASQUINI

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[1] P Pasquini *Boll Ist Zool Roma*, vol 5 1927
[2] S R Detwiler, *Arch für Entwicklungsmech* Bd 116 1929
[3] R M May and S R Detwiler *Jour Exp Zool* vol 43 1925
[4] R M May *Arch de Biol* v 1 37 1927
[5] H S Burr *Anat Rec* vol 25, 1923 *Proc Soc Exp Biol Med* 21 1924, *Jour Exp Zool* vol 55, 1930
[6] V Twitty *Proc Soc Exp Biol Med* 26, 1929
[7] P Pasquini *Rend R Acc Naz Lincei* 10 serie 6, 2 sem 1929
[8] R G Harrison *Arch für Entwicklungsmech* Bd 120 1929

Periodic Fluctuations in a Vertical Temperature Gradient

THE accompanying diagram (Fig 1) suggests a striking example of wave motion in the vertical temperature gradient at St Hubert Airport near Montreal during a large inversion of lapse rate in the

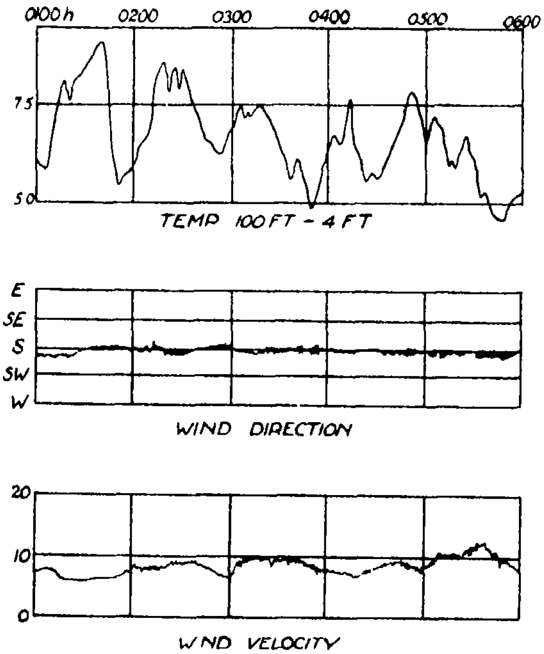


FIG 1

early morning of Oct 12 1930 The upper curve shows the temperature at 100 feet above the ground minus that at 4 feet in degrees Fahrenheit The lower curves show the velocity and direction of the wind at 60 feet

Five complete waves occur in the vertical gradient between 0105 hours and 0520 hours with an average period of about 50 minutes The gradient in question was measured by platinum resistance thermometers continuously ventilated by a fan

The barometer was very steady, and the wind unusually so At this time, the station was about 300 miles from the centre of a large, slow moving anticyclone about 1500 miles in diameter Very light winds had prevailed for three days, and unseasonably high daytime temperatures There is no information about cloud at this station at night, but the skies were cloudless for two days before and the day after, which renders it likely that the night was clear The country to the south of St Hubert (from which direction the wind was blowing) is very flat for some miles

During more or less stationary anticyclonic conditions, fluctuations of the same general magnitude often occur in the early hours of the morning but in this example the periodicity is especially apparent

W E KNOWLES MIDDLETON

Meteorological Office,
315 Bloor Street, West
Toronto (5) Dec 15

The Value of M/m

PROF H S ALLEN has directed my attention to the short account in NATURE of Dec 13 p 942, of a recent paper by Sir Arthur Eddington, in which Sir Arthur suggests on theoretical grounds that $M/m - (136)^2/10 - 1849\ 6$ Prof Allen in 1915 suggested[1] that a relationship of this type might be true

Assuming that $M_H/m = 1850\ 6$ and taking the values of the Faraday constant and atomic weight of hydrogen as given by Birge,[2] I deduce

$$e/m \quad (1\ 7719 \pm 0\ 0001_3) \times 10^7$$

Now this is not only higher than I estimate[3]

$$\left.\begin{matrix} 1\ 7688_2 \pm 0\ 0006_3 \\ 1\ 767_7 \pm 0\ 001 \end{matrix}\right\} \times 10^7$$

but also is higher than the values given by Birge[4] higher than two recent determinations[5] and higher than all the final values tabulated in the Handbuch der Physik (22, p 81) and in J J and G P Thomson's Conduction of Electricity through Gasses (1, p 264) with the exception of the one higher determination of Classen This seems to me sufficient evidence to show that M_p/m cannot be exactly 1849 6 There is however more evidence to this effect

Using the estimate $e/m = (1\ 7719 \pm 0\ 0001_3) \times 10^7$ together with Rydberg's formula and Eddington's equation $hc/2\pi e^2 = 137$ (experimental evidence for which I explained in my December paper) I deduce

$$e - (4\ 771_6 \pm 0\ 0004) \times 10^{-10}$$
$$h \quad (6\ 537_3 + 0\ 0009) \times 10^{-27}$$

(for the subsidiary data I have used Birge's values) These estimates of e and h may at first seem acceptable enough but when they are compared with the determinations of h by five other methods as given by Birge[6] using the graphical method given in my paper, it is found that all five deviate from the present estimates *in the same sense* As there is only a probability of 1/16 of the five being all in error in the same sense I can only conclude that this is more evidence against the equation $M/m = 1849\ 6$

W N BOND

Department of Physics
University of Reading
Jan 3

[1] *Proc Phys Soc* 27 p 430
[2] *Phys Rev* Supplement v 1 1 No 1 pp 1 73
[3] *Phil Mag* Dec 1930
[4] Loc cit
[5] *Phys Rev* 1930
[6] Loc cit p 57

Giant Oysters

DR ORTON[1] has given the dimensions and weight of two exceptionally large specimens of *O edulis*, which have led to interesting comparisons The closely allied southern Australian species, *O sinuata* (*angasi*), normally grows to a large size, specimens 1 lb in weight being quite common The largest specimen of this species which I have seen weighed when wet, but without meat, 2 lb 3 oz , the dry shells weigh 1 lb 4½ oz This oyster is 6½ inches long, 7 inches broad, and 3 inches deep It was gathered in George's Bay, Tasmania, and local residents informed me that they have seen considerably larger samples

The largest oyster we have here in our collection is a specimen of *O crista-galli* from the Great Barrier Reef, North Queensland (Fig 1) It weighs (dry shells)

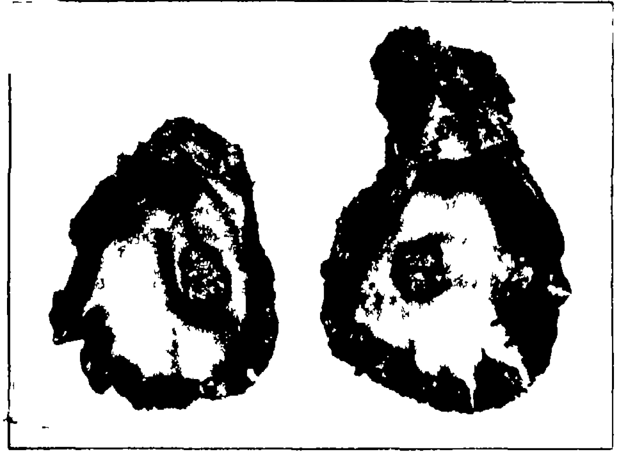


FIG 1 —*Ostrea crista galli* from the Great Barrier Reef North Queensland

4 lb 2½ oz When alive it probably weighed in the vicinity of 5 lb Its dimensions are length 9¾ inches, breadth 6½ inches, depth 4½ inches This oyster had attained a great age, as indicated by the extraordinary development of the umbo of the right shell, which is 3½ inches long Saville Kent, in his "Great Barrier Reef of Australia", p 244, states that oysters of this species 'not unfrequently weigh as much as from 5 to 7 lb and have a diameter of from eight to twelve inches"

It will be interesting to learn which species of the world wide genus *Ostrea* attains the largest size

T C ROUGHLEY

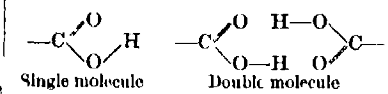
Technological Museum,
Sydney, N S W

[1] NATURE, Aug 30 1930 p, 300

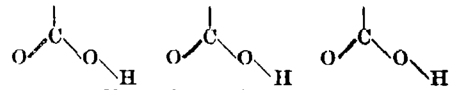
Adhesive Forces in Surface Films

DR N K ADAM's contention (NATURE, Dec 20, 1930), that the molecules of a fatty acid on the surface of water may be held together by the mutual attraction of the 'heads', even when the hydrocarbon chains are in such violent agitation as to have lost all adhesive force, may be thrown into a more precise form by making use of the conception of the co ordination of hydrogen,[1] which has also been described more picturesquely as "Bigamous Hydrogen"[2] This conception serves to account for the formation of the acid fluoride ion [FHF]$^-$, but was first applied by Pfeiffer,[3] so long ago as 1913, in order to account for the lack of acidic properties in *o*-hydroxy anthraquinone

The interaction between contiguous –OH and >C=O groups, which Pfeiffer postulated, has already been used to account for the peculiar properties of the two radicals when united to form a carboxyl group,[4] and for the formation of double molecules both in the vapour and in crystals of carboxylic acids It is, therefore, an obvious step to make use of it also to account for the adhesion between contiguous molecules in a monomolecular film of a fatty acid on the surface of water The three methods in which carboxyl groups may be affected by this co ordination may be indicated by the following formulæ, where the hydrogen is supposed to be under the influence of both of the oxygen atoms to which it is adjacent



Single molecule Double molecule



Monomolecular film

T M LOWRY

Laboratory of Physical Chemistry,
University of Cambridge,
Dec 24

[1] Lowry and Burgess *Trans Chem Soc*, **123** 1866, 1923
[2] Armstrong NATURE April 17 1926
[3] *Ann* **398** 152
[4] G N Lewis Valence , pp 154 155

Spectrum of Doubly Ionised Iodine

THIS spectrum has been under investigation for some time past in the visible and ultra violet regions, and it has been found that a good many of the strong lines owe their origin to the terms of $2O_2P_1$, $2O_2P_2$, and $2O_2P_3$ electronic configurations All the quartet terms for these have been recognised, the lines originating from them having been obtained by a consideration of the spectra of doubly ionised indium tin, and antimony which have been elucidated by various investigators In spite of the difficulties of correctly estimating the intensities of lines for highly ionised elements, the multiplets in the present case follow the usual intensity rules fairly well The $2O_2(P_1 \leftarrow P_2)$ and $2O_2(P_2 \leftarrow P_3)$ lines are grouped about the region λλ 3900 A and 3100 A respectively The following table gives the separations which occur between the components of a few of the principal multiple terms For the purpose of comparison the corresponding separations in the analogous spectra of doubly ionised fluorine, chlorine, and bromine (already determined by previous investigators) have also been included in the table

Elements		F^{++}	Cl^{++}	Br^{++}	I^{++}
Atomic No		9	17	35	53
P in X_1 level	$P_1 - P_2$	211	358	518	576
	$P_2 - P_3$	319	520	838	1090
D in X_2 level	$D_1 - D_2$	115	260	332	320
	$D_2 - D_3$	190	430	576	625
	$D_3 - D_4$	259	600	748	830

Full details will be published elsewhere

J B SETH

Physics Laboratory,
Government College, Lahore,
Dec 29

Agricultural Field Experiments

IN the correspondence on this subject in NATURE of Nov 29 last, p 843, ' The Writer of the Article " suggests that depth of sowing in wheat plays an important part in accurate field experiments Many years' experience on the black cotton soils of Central India and on the alluvium of the Indo Gangetic plain fully confirms this view Until quite recently, the practice among the cultivators round Indore was to sow wheat by means of a bamboo tube fixed behind the country plough The consequence was that many of the seeds germinated but the seedlings never reached the surface In dry years particularly, when many of the seeds were covered by large clods, a very uneven stand was obtained Some years ago, a member of the staff of this Institute Mr K R Joshi, devoted a good deal of time to the study of this question, and found that much better and more even stands of wheat could be obtained by the two coulter Gujerati drill, which deposits the seed in the moist layer of soil just below the dry surface mulch The cultivators are now rapidly changing their practice, and the drilling of wheat is now to be seen in many of the villages on the Malwa plateau I have myself, on the alluvial soils of the plains often observed the deleterious effect of sowing wheat too far below the surface

In both plant breeding work on wheat and in variety trials too much attention cannot be paid to correct farming procedure It is obvious in such questions that nothing can be gained by the application of formulæ and figures to the results obtained by poor agriculture

ALBERT HOWARD

Institute of Plant Industry,
Indore Central India
Dec 26

Wisdom in Words

THE time may come

When the Gates cease to ruggle
When the Danes hald in juggle
And the Brides can write no more

that Lamarckian moonshine will no longer be adumbrated in terms of Hibernian green and questions as to the meaning of life will be discussed in language that has plain meaning Awaiting that far off day, we may ask What is the difference between a philosopher and a scientific man—can either, if there be two of them, be as such ' ? Mr Bartrum would treat them as beings apart The one term is Greek, the other Latin of sorts The one is a man who has and uses knowledge, maybe makes it The other is a lover of knowledge of wisdom but it is impossible to love without having and using and even seeking for an increase in return Seeing that it is the business of the scientific man *to know*, truth is his clear concern in his every search Faraday, *the scientific man* ' par excellence ' in history, ever the seeker after truth and wisdom definitely elected to call himself a *philosopher*, he also sought to use a clear language Surely our present need is to get rid of the flossofer ' *as such*— the mere man of words, who but thinks he knows

Is there more behind all this pother about evolution and vitalism —not to mention entelechy—than mere word slinging ? Have we not had more than enough of it to satisfy our present state of ignorance of intimate organic structure ? That we can see the chromosome is wonder enough Let us leave it at that, until we can put some real chemistry into its purse , all talk of ' autocatalysis ' is just meaningless, pretentious phrasing INQUIRER

Determination of the Velocities of Projectiles by Light Interception.

THE principle of the method for the determination of the velocity of projectiles described by Taylor and Wark in the issue of NATURE for Dec 27, p 994, has been used previously, notably by Kampé de Fériet, who published a full description, illustrated with some excellent photographs, in 1925 (*Mem de l'Art franc*, vol 4, p 289) Using what was essentially a single but comparatively wide band of light, a continuous record was obtained of the flight of the projectile for a distance of 25 metres

Consideration of the flight of solid projectiles has been helpful to us in our investigation of the solid particles sent out at high speed by coal mining explosives For this purpose, using our ' wave speed camera (Safety in Mines Research Board, *Paper* No 29, 1926), we have developed a method of recording photographically the movement of rifle bullets By this means we have obtained a continuous light interception record similar to those of Kampé de Fériet, but combined with a continuous *Schlieren* record of the atmospheric pressure waves and the powder gases, visible or invisible, sent out from the rifle

The results have been embodied in a paper which will be published at an early date

W PAYMAN,
D W WOODHEAD

Safety in Mines Research Board,
Research Station, Harpur Hill,
Buxton Derbyshire, Jan 3

School Natural History Societies

IT has been brought to the notice of the Corresponding Societies Committee of the British Association that a number of noteworthy scientific and natural history societies exist in connexion with public schools of which the Committee would welcome brief particulars of their origin and development, together with an epitome of practical work attempted in their respective districts, especially where the observations have been published

It would be a valued assistance to my Committee if any readers of NATURE could conveniently furnish me with the names of societies of this kind known to them which, in their opinion, might be invited to contribute some particulars as to work accomplished to a report which it is proposed to prepare for the centenary meeting of the Association in September next CLARENCE TIERNEY

British Association
Burlington House London, W 1,
Jan 16

Synthesis of Munjisthin

A MISTAKE in nomenclature has, through our inadvertence, crept into our communication on the " Synthesis of Munjisthin , published in NATURE of Nov 15, 1930, page 761, which we hasten to rectify

In line 6 par 2, instead of "2 chloro 3 methyl 4 methoxy", read 1 chloro 2 methyl 3 methoxy" and in lines 8 9 of the same par , instead of " 2 chloro 3 methyl 4 hydroxy , read ' 1 chloro 2 methyl 3 oxy "

The mistake, which we very much regret, is due to our overlooking the fact that the position (2') in the formula of benzoyl benzoic acid becomes the position (1) in the formula of the anthraquinone

P C MITTER
HAROGOPAL BISWAS

22 Garpar Road, Calcutta, Dec 8

Present Status of Theory and Experiment as to Atomic Disintegration and Atomic Synthesis *

By Prof ROBERT A MILLIKAN, California Institute of Technology, Pasadena, California

MY task is to attempt to trace the history of the development of scientific evidence bearing on the question of the origin and destiny of the physical elements I shall list ten discoveries or developments, all made within the past hundred years, which touch in one way or another upon this problem and constitute indications or sign-posts on the road toward an answer

Prior to the middle of the nineteenth century, little experimental evidence of any sort had appeared, so that the problem was wholly in the hands of the philosopher and the theologian Then came, first, the discovery of the equivalence of heat and work, and the consequent formulation of the principle of the conservation of energy, probably the most far-reaching physical principle ever developed

Following this, and directly dependent upon it, came, second, the discovery, or formulation, of the second law of thermodynamics, which was first interpreted, and is still interpreted by some, as necessitating the ultimate 'heat-death' of the universe and the final extinction of activity of all sorts, for all hot bodies are observed to be radiating away their heat, and this heat after having been so radiated away into space apparently cannot be reclaimed by man This is classically and simply stated in the humpty-dumpty rhyme As a natural if not necessary corollary to this was put forward by some, in entire accord with the demands of medieval theology, a *Deus ex machina* initially to wind up or start off this running-down universe

Then came, third, the discovery, through studies both in geology and biology, of the facts of evolution—facts which showed that, so far as the biological field is concerned, the process of creation, or upbringing from lower to higher forms, has been continuously going on for millions upon millions of years and is presumably going on now This tended to direct attention away from the *Deus ex machina*, to identify the Creator with his universe, to strengthen the theological doctrine of immanence, which represents substantially the philosophic position of Leonardo da Vinci, Galileo, Newton, Francis Bacon, and most of the great minds of history down to Einstein

Neither evolution nor evolutionists have in general been atheistic—Darwin least of all—but their influence has undoubtedly been to raise doubts about the legitimacy of the dogma of the *Deus ex machina* and of the correlative one of the heat-death This last dogma rests squarely on the assumption that we, infinitesimal mites on a speck of a world, know all about how the universe behaves in all its parts, or more specifically, that the radiation laws which seem to us to hold here cannot possibly have any exceptions anywhere, even though that is precisely the sort of sweeping generalisation that has led us physicists into error half a dozen times during the past thirty years, and also though we know quite well that conditions prevail outside our planet which we cannot here duplicate or even approach Therefore the heat-death dogma has always been treated with reserve by the most thoughtful of scientific workers No more crisp or more cogent statement of what seems to me to be the correct position of science in this regard has come to my attention than is found in the following recent utterance of Gilbert N Lewis, namely, "Thermodynamics gives no support to the assumption that the universe is running down" "*Gain of entropy always means loss of information and nothing more*"

The fourth discovery bearing on our theme was the discovery that the dogma of the immutable elements was definitely wrong By the year 1900 the element radium had been isolated and the mean lifetime of its atoms found to be about two thousand years This meant definitely that the radium atoms that are here now have been formed within about that time, and a year or two later the element helium was definitely observed to be growing out of radium here and now This raised insistently the question as to whether the creation, or at least the formation, of all the elements out of something else may not be a continuous process—stupendous change in viewpoint the discovery of radioactivity brought about, and a wholesome lesson of modesty it taught to the physicist But a couple of years later, uranium and thorium, the heaviest known elements, were definitely caught in the act of begetting radium, and all the allied chain of disintegration products Since, however, the lifetime of the parent atom, uranium, has now been found to be a billion years or so, we have apparently ceased to inquire whence it comes We are disposed to assume, however, that it is not now being formed on earth Indeed, we have good reason to believe that the whole radioactive process is confined to a very few, very heavy elements which are now giving up the energy which was once stored up in them—we know not how—so that radioactivity, though it seemed at first to be pointing away from the heat death, has not at all, in the end, done so Indeed, it seems to be merely one mechanism by which stored-up energy is being frittered away into apparently unreclaimable radiant heat—another case of humpty dumpty

The fifth significant discovery was the enormous lifetime of the earth—partly through radioactivity itself, which assigns at least a billion and a half years—and the still greater lifetime of the sun and stars—thousands of times longer than the periods through which they could possibly exist as suns if they were simply hot bodies cooling off This meant that new and heretofore unknown sources of heat energy had to be found to keep the stars pouring out such enormous quantities of radiation for such ages upon ages

* Retiring presidential address to the American Association for the Advancement of Science, delivered at Cleveland on Dec 29

The sixth discovery, and in many ways the most important of all, was the development of evidence for the interconvertibility of mass and energy This came about in three ways In 1901 Kaufman showed experimentally that the mass of an electron could be increased by increasing sufficiently its velocity that is, energy could be definitely converted into mass About the same time the pressure of radiation was experimentally established by Nichols and Hull at Dartmouth College, New Hampshire, and Lebedew at Moscow This meant that radiation possesses the only distinguishing property of mass, the property by which we define it, namely, inertia The fundamental distinction between radiation and matter thus disappeared These were direct, experimental discoveries Next, in 1905, Einstein developed the interconvertibility of mass and energy as a necessary consequence of the special theory of relativity If, then, the mass of the sun could in any way be converted into radiant heat, there would be an abundant source of energy to keep the sun going so long as necessary, and all our difficulties about the lifetimes of the sun and stars would have disappeared But what could be the mechanism of this transformation ?

Then came the seventh discovery, which constituted a very clear finger post, pointing to the possibility of the existence of an integrating or building-up process among the physical elements, as well as in biological forms, in the discovery that the elements are all definitely built up out of hydrogen , for they—the ninety-two different atoms—were all found, beginning about 1913 by the new method of so-called positive ray analysis, to be exact multiples of the weight of hydrogen within very small limits of uncertainty This fact alone raises very insistently the query as to whether they are not being built up somewhere out of hydrogen now They certainly were once so put together, and some of them, the radioactive ones, are now actually caught in the act of splitting up Is it not highly probable, so would say any observer, that the inverse process is going on somewhere, especially since the process would involve no violation either of the energy principle or of the second law of thermodynamics, for hydrogen, the element out of which they all must be built, has not a weight exactly one in terms of the other ninety-two, but about 1 per cent more than one, so that since mass or weight had been found in the sixth discovery to be expressible in terms of energy, the union of any number of hydrogen atoms into any heavier element, meant that 1 per cent of the total available potential energy had disappeared and was therefore available for appearance as heat

When, about 1914–15, this fact was fitted by MacMillan, Harkins, and others into the demand made above in the fifth discovery for a new source of energy to keep the sun pouring out heat so copiously for such great lengths of time, it seemed to the whole world of physics that the building up of the heavier elements out of hydrogen under the conditions existing within the sun and stars had been practically definitely proved to be taking place This would not provide an escape from the heat-death, but it would enormously postpone it, that is, until all the hydrogen in the universe had been converted into the heavier elements

By this process, however, the suns could stoke at most but 1 per cent of their total mass, assuming they were wholly hydrogen to begin with, into their furnaces, and 99 per cent of the mass of the universe would remain as cold, dead ash when the fires were all gone out and the heat-death had come But about 1917 the astronomer began to chafe under the time-limitation thus imposed upon him, and this introduced the eighth consideration bearing upon our theme He could get a hundred times more time—from now on, much more than that, because only a small fraction of the matter in the universe is presumably now hydrogen—by assuming that, in the interior of heavy atoms, occasionally a negative electron gets tired of life at the pace it has to be lived in the electron world, and decides to end it all and commit suicide , but, being paired by Nature in electron-fate with a positive, he has to arrange a suicide pact with his mate, and so the two jump into each other's arms in the nucleus, and the two complementary electron lives are snuffed out at once , but not without the letting loose of a terrific death-yell, for the total mass of the two must be transformed into a powerful ether pulse which, by being absorbed in the surrounding matter, is supposed to keep up the mad, hot pace in the interiors of the suns This discovery, or suggestion, to account for the huge estimated stellar lifetimes, of the complete annihilation of positive and negative electrons within the nucleus, makes it unnecessary to assume, at least for stellar lifetime purposes, the building up of the heavier elements out of hydrogen Indeed, it seems rather unlikely that both kinds of processes, atom building and atom annihilating, are going on together in the same spot under the same conditions , so we must turn to further experimental facts to get more light

The ninth sign-post came into sight in 1927, when Aston made a most precise series of measurements on the relative masses of the atoms, which made it possible to subject to a new test the Einstein formula for the relation between mass and energy, namely, $E = Mc^2$ This Aston curve is one of the most illuminating finger-pointings we now have It shows that

1 Einstein's equation actually stands the quantitative test for radioactive or disintegrating processes right well, and therefore receives new experimental credentials

2 The radioactive or disintegrating process with the emission of an alpha ray must be confined to a very few heavy elements, since these are the only ones so situated on the curve that mass can disappear, and hence heat energy appear, through such disintegration

3 All the most common elements, except hydrogen, are already in their most stable condition, that is, their condition of minimum mass, so that if we disintegrate them we shall have to do work upon them, rather than get energy out of them

4 Therefore, man's only possible source of

energy other than the sun is the upbuilding of the common elements out of hydrogen or helium, or else the entire annihilation of positive and negative electrons, and there is no likelihood that either of these processes is a possibility on earth

5 If the foregoing upbuilding process is going on anywhere, the least penetrating and the most abundant radiation produced by it, that corresponding to the formation of helium out of hydrogen, ought to be about ten times as energetic as the hardest gamma rays, that is, it ought to correspond to about twenty-six million electron-volts in place of two and a half million

6 Other radiations corresponding to the only other abundant elements, namely, oxygen (oxygen, nitrogen, carbon), silicon (magnesium, aluminium, silicon), and iron (iron group), should be found about four times, seven times, and fourteen times as energetic as the 'helium rays'

7 The radiation corresponding to the smallest annihilation process that can take place—the suicide of a positive and negative electron—is three hundred and fifty times as energetic as the hardest gamma ray, or thirty-five times as energetic as the 'helium ray'

This brings us to the tenth discovery, that of the cosmic rays These reveal *

1 A radiation, the chief component of which, according to our direct comparison, is five times as penetrating as the hardest gamma ray, which, with the best theoretical formula we have relating energy and penetrating power (Klein-Nishina), means a ray ten times as energetic as the hardest gamma ray, *precisely according to prediction*

2 Special bands of cosmic radiation that are roughly where they should be to be due to the formation of the foregoing abundant elements out of hydrogen, though (for reasons to be given presently) no precise quantitative check is to expected except in the case of helium

3 No radiation of significant amount anywhere near where it is to be expected from the annihilation hypothesis, thus indicating that at least 95 per cent of the observed cosmic rays are due to some other less energetic processes

4 A radiation that is completely independent of the sun, the great hot mass just off our bows, and not appreciably dependent on the Milky Way or the nearest spiral nebula, Andromeda, one that comes in to us practically uniformly from all portions of the celestial dome, and is so invariable with both time and latitude at a given elevation that the observed small fluctuations at a given station reflect with much fidelity merely the changes in the thickness of the absorbing air blanket through which the rays have had to pass to get to the observer

This last property is the most amazing and the most significant property exhibited by the cosmic rays, and before drawing the final conclusions its significance will be discussed For it means that at the time these rays enter the earth's atmosphere, they are practically pure ether waves or photons

* See articles by Millikan and by Millikan and Cameron, *Phys Rev*, Dec 1, 1930, and in press

If they were high-speed electrons or even had been appreciably transformed by Compton encounters in passing through matter into such high-speed electrons or beta rays, these electrons would of necessity spiral about the lines of force of the earth's magnetic field and thus enter the earth more abundantly near the earth's magnetic poles than in lower latitudes This is precisely what the experiments made during the last summer at Churchill, Manitoba (lat 59° N), within 730 miles of the north magnetic pole, showed to be *not true*, the mean intensity of the rays there being not measurably different from that at Pasadena in lat 34° N

Nor is the conclusion that the cosmic rays enter the earth's atmosphere as a practically pure photon beam dependent upon these measurements of last summer alone It follows also from the high altitude sounding balloon experiments of Millikan and Bowen in April 1922, taken in connexion with the lower balloon flights of Hess and Kolhorster in 1911-14 For in going to an altitude of 15 5 km we got but one fourth the total discharge of our electroscope which we computed we should have obtained from the extrapolation of our predecessors' curves This shows that somewhere in the atmosphere below a height of 15 5 km the intensity of the ionisation within a closed vessel exposed to the rays goes through a maximum, and then decreases, quite rapidly, too, in going to greater heights We have just taken very accurate observations up to the elevation of the top of Pike's Peak (4 3 km), and found that within this range the rate of increase with altitude is quite as large as that found in the Hess and Kolhorster balloon flights, so that there can be no uncertainty at all about the existence of this maximum Such a maximum, however, means that the rays, before entering the atmosphere, have not passed through enough matter to begin to get into equilibrium with their secondaries—beta rays and photons of reduced frequency—in other words, *that they have not come through an appreciable amount of matter in getting from their place of origin to the earth*

This checks with the lack of effect of the earth's *magnetic field* on the intensity of the rays, and the two phenomena, of quite unrelated kinds and brought to light years apart, when taken together, prove most conclusively, I think, that the cosmic rays cannot originate even in the outer atmospheres of the stars, though these are full of hydrogen and helium in a high temperature state, but that they must originate rather in those portions of the universe from which they can come to the earth without traversing matter in quantity that is appreciable even as compared with the thickness of the earth's atmosphere—in other words, that *they must originate in the intensely cold regions in the depths of interstellar space*

Further, the more penetrating the beta rays produced by Compton encounters, the greater the thickness of matter that must be traversed before the beam of pure photons which enters the atmosphere gets into equilibrium with its secondaries, and until such equilibrium is reached, the apparent

absorption coefficient must be less than the coefficient computed with the aid of the Klein-Nishina formula from the energy released in the process from which the radiation arises. Now the Bothe Kolhorster experiments of about a year ago show that when the energies of the incident photons are sufficiently high, the beta rays released by Compton encounters do indeed become abnormally penetrating, so that it is to be expected that, for the cosmic rays produced by the formation of the heavier of the common elements like silicon and iron out of hydrogen, the observed absorption coefficients will be somewhat smaller than those computed from the energy available for their formation. This is precisely the behaviour which our cosmic ray depth-ionisation curve actually reveals. At the highest altitudes at which we have recently observed (14,000 ft.), the helium rays have reached equilibrium with their secondaries, and the observed and computed coefficients agree as they should. For the oxygen rays the observed coefficent is a little lower than the computed value—about 17 per cent lower; for the silicon rays still lower—about 30 per cent; and for the iron rays considerably lower still—about 60 per cent; all in beautiful qualitative agreement with the theoretical demands as outlined.

The foregoing results seem to point with much definiteness to the following conclusions:

1. The cosmic rays have their origin not in the stars but rather in interstellar space.

2. They are due to the building up in the depths of space of the commoner heavy elements out of hydrogen, which the spectroscopy of the heavens shows to be widely distributed through space. That helium and the common elements oxygen, nitrogen, carbon, and even sulphur, are also found between the stars is proved by Bowen's beautiful recent discovery that the 'nebulium lines' arise from these very elements.

3. These atom-building processes cannot take place under the conditions of temperature and pressure existing in the sun and stars, the heats of these bodies having to be maintained presumably by the atom-annihilating process postulated by Jeans and Eddington as taking place there.

4. All this says nothing at all about the second law of thermodynamics or the *Wärme-Tod*, but it does contain a bare suggestion that if atom formation out of hydrogen is taking place all through space, as it seems to be doing, it may be that the hydrogen is somehow being replenished there, too, from the only form of energy that we know to be all the time leaking out from the stars to interstellar space, namely, radiant energy. This has been speculatively suggested many times before, in order to allow the Creator to be continually on his job. Here is, perhaps, a little bit of *experimental* finger-pointing in that direction. But it is not at all proved or even perhaps necessarily suggested. If Sir James Jeans prefers to hold one view and I another on this question, no one can say us nay. The one thing of which we may all be quite sure is that neither of us *knows* anything about it. But for the continuous building up of the common elements out of hydrogen in the depths of interstellar space the cosmic rays furnish excellent experimental evidence. I am not unaware of the difficulties of finding an altogether satisfactory kinetic picture of how these events take place, but acceptable and demonstrable facts do not, in this twentieth century, seem to be disposed to wait on suitable mechanical pictures. Indeed, has not modern physics thrown the purely mechanistic view of the universe root and branch out of its house?

Geodesy in India

IN the British Empire at the present time, geodetic operations are mainly confined to Canada, India, and South Africa. The Dominion and the Union are working principally for the more pressing needs of development; in India, on the other hand, apart from the necessity for revision, more attention is being paid to the interpretation of results. The Great Trigonometrical Survey of India itself being long complete, triangulation is now being carried on in the outer zones—in Burma and on the Siamese frontier at the date of the last Geodetic Report.[1]

The main triangulation in 1928-29 was executed with Wild theodolites, which gave very good results when the instruments were working. Their axes, however, stiffened in the field, causing serious loss of time. Surveyors cannot adjust the instruments in the field, and even the mathematical instrument workshop in Calcutta found adjustment difficult, though mere oiling is simple if the method is known. It was intended to keep the older and heavier 12-inch theodolites at hand during the ensuing season, in case of further failures.

Precise levelling is perhaps the most economically important section of the revisionary geodetic work: of the new net of 16,000 miles proposed, nearly one half was completed in 1929. Levelling on hilly circuits appears to show that the shorter sights thereon contribute to accuracy as against longer sights in flat country; experience in precise levelling has given revised results on hilly circuits in Ceylon which are practically as good as on the plains. Indian investigations show that error due to differential refraction on steep slopes is negligible, and the greater part of the errors of closure is believed to be due to changing length of the staves. The results of levelling must lie within limits of accidental and systematic error which are strictly defined; one notices that 55 per cent of one line was relevelled. On the several lines—not yet, of course, referred strictly to M.S.L.—the relative discrepancies between the new and the old measures do not ordinarily exceed 6 inches; but there are interesting exceptions. Thus there is evidence of a sinkage around Ambala of about an inch per decade, attributed to removal of water from wells. On the line between Sukkur and Hyderabad the results of much levelling have given

measures so discordant that it has been decided to abandon the line India has hitherto used wooden staves, and it is not stated if these have been rendered non-hygroscopic, change in length, which appears to have a diurnal range, being attributed to temperature In any event, staves with invar strips were to be substituted

Heights are subject to orthometric and dynamic corrections, the former to take account of the non-parallelism of the equipotential surfaces at different altitudes, the latter to refer all heights to a standard equipotential surface of sea-level at a mean latitude, in India 24° north The corrections are easily computed by formulæ, in which case they depend on theoretical, not observed, values of gravity The Director of the Geodetic Branch, Dr De Graaf Hunter, discusses the question of a rigorous investigation, and finds that the effect at Mussoorie, 7000 feet, is 0 7 ft, he concludes that the severe labour involved in applying a rigorous correction is not justifiable in hilly country and is unnecessary in flat country, even though in strictness values derived by formula give heights in an unknown unit above an unknown datum

India controls tide-gauges at forty eastern ports and issues predictions An outstanding discrepancy in 1928 was 4 6 feet at Basrah on a certain date—not surprising at the mouth of great rivers and at the head of a great gulf By arrangement with the Admiralty, the tide-tables will be extended to sixty-eight ports in the Indian Ocean, and they will be issued in cheaper form—sufficient evidence of the success of the Survey in deriving harmonic constants in a region where monsoons and unique tides must sometimes give rise to peculiar conditions

It has been decided to re-map at least a portion of the Dependency on areas of conical orthomorphic projection, in such an immense area the change over will be gradual The areas proposed are 8° in latitude by 16° in longitude In this matter South Africa and India represent extreme views, the former adopting a width of 2° as against 8° in India At the bounding parallels the scale error is about 1/400, which will be reduced one-half by a scale factor The magnitude of the scale error and, perhaps more particularly, the rapid change of scale at the bounding parallels will doubtless evoke criticism

The Survey has constructed a mural base for standards of length Such bases already exist at Sèvres and Teddington, yet the writer doubts if this is the best form of construction, even though the thermal expansion of the wall becomes fairly well known after some years

In the course of the longitude campaign the variation of latitude was studied, the results appear to show a well-marked correlation with the moon's age, as already described in NATURE [2] The mean longitude of Dehra Dûn as derived from the Bordeaux and Rugby signals in 1928–29 is 5 h 12 m 11 79 s, precisely the same as in the longitude campaign of 1926 A Shortt clock was installed this year to supplement the Riefler

The most interesting portions of the Report deal with gravity and the geoid in India, it would be impossible to deal adequately in a short review with the wealth of material here provided The Director reaffirms his conclusion that conditions of approximately perfect Hayford isostasy are not met with in peninsular India, but the interested reader must be referred to the Report itself for a description of the numerous investigations Work with the Cambridge pendulum apparatus is being vigorously pursued, old values being revised and new stations added, with the object of having one station in every seventy mile square

The Survey of India has made remarkable contributions to geodesy in the past It is doubtful if any single volume has approached in interest and instruction that of the year under review

G T McC

[1] Geodetic Report, Vol 5, of the Survey of India From Oct 1 1928, to Sept 30 1929 Published by order of Brigadier R H Thomas, Surveyor General 8vo, pp 150+29 charts (Dehra Dûn Geodetic Branch Office 1930) 5s 3d

[2] Bomford G NATURE, June 8 1929 vol 123, p 873

Obituary

THE death on Dec 28 of Prof Eugen Goldstein, head of the Astro-Physical Section of the Potsdam Observatory, removes an observer whose work on the phenomena which accompany the passage of electricity through rarefied gases is well known He was born at Gleiwitz on Sept 5, 1850, was educated at the Ratibor Gymnasium and the Universities of Breslau and Berlin At Berlin he worked under Helmholtz at the electric discharge in vacuum tubes, and in 1876 his first paper on the subject appeared in the *Berliner Berichte*, and was followed for fifty years by a long series dealing with cathode and anode rays and the influence of magnetic fields and of the dimensions of the discharge tube on the character of the discharge He maintained throughout that the luminous discs of the positive column were repetitions with decreased intensity of the cathode glow His recent work was mainly on the complex discharge near the anode, but he is probably best known for his discovery of the anode or canal rays He was awarded the Hughes Medal by the Royal Society in 1908

WE regret to announce the following deaths

Mr R G Lunnon, lecturer in physics at Armstrong College, Newcastle

Dr A P Maudslay, president in 1911–12 of the Royal Anthropological Institute, who was well known for his investigations of Mayan and Aztec sites in Mexico and Central America, on Jan 22, aged eighty-one years

Mr H W Monckton, sometime treasurer and several times vice president of the Geological Society, and vice president and treasurer of the Linnean Society up to the time of his death, on Jan 14, aged seventy-four years

Prof C Y Wang, professor of pathology in the University of Hong Kong, author of numerous papers on tuberculosis and other bacterial diseases, on Dec 16, aged forty two years

News and Views.

AT a recent meeting of the Council of the University of Bristol, an announcement was received with much gratification of two munificent offers for the endowment of research in physics, one from the Rockefeller Foundation and one from Mr W Melville Wills Impressed by the possibilities of the Henry Herbert Wills Physical Laboratory as a centre of research, the Rockefeller Foundation offered the sum of £50,000 to the University of Bristol for the endowment of research in experimental and theoretical physics, on condition that a further contribution of £25,000 for the same purpose was secured from other sources Mr Melville Wills, already a benefactor to the University, has most generously offered to give the required sum of £25,000 in memory of his late brother, the founder of the laboratory Thanks to this further act of beneficence by a member of the Wills family, the University has been able to accept the Rockefeller Foundation's offer The laboratory was founded by a gift of £200,000 from the late Mr Henry Herbert Wills, and was opened in 1927 under the direction of Prof A M Tyndall A broad view of the term 'laboratory' was taken, and a professorship in theoretical physics was created so that the closest co operation between theory and experiment might be effected in the laboratory With the concurrence of the Rockefeller Foundation, the gift of Mr Melville Wills will be utilised for the endowment of the chair at present held by Prof J E Lennard Jones in theoretical physics One portion of the Rockefeller gift will be devoted to researches in the field of molecular structure and the borderland of physics and chemistry, to which the laboratory has already contributed on both the theoretical and the experimental sides After providing for certain other immediate needs, the remainder of the gift will form a reserve to meet the growing requirements of the laboratory as a centre of research

ON Feb 5 occurs the centenary of the death of Commander Henry Foster who in 1827 was awarded the Copley Medal of the Royal Society for his magnetic observations made in the Arctic regions Born in August 1796, Foster was the eldest son of a clergyman of Woodplumpton, near Preston, Lancs, and joined the Navy as a volunteer in 1812 He served in various parts, and after the Napoleonic wars became known as a surveyor He accompanied Basil Hall to South America in 1820, served under Parry in the *Hecla* in 1824 and in 1827, and it was for his work in the *Hecla* that he was awarded the Copley Medal Promoted to commander, he was appointed to the command of the *Chanticleer*, commissioned by the Admiralty, at the request of the Royal Society, for determining the ellipticity of the earth Foster sailed in April 1828, visiting South America and the Cape and then Panama, where he unfortunately met his death by accidental drowning in the River Chagres His body was recovered and a monument was erected over his grave There is also a tablet to his memory in Woodplumpton Church Foster's pendulum experiments, carried out at fourteen different stations between 10° 38′ north latitude and 62° 56′ south latitude, were made with the most scrupulous regard to accuracy, and they were the most extensive series of experiments made up to that time After his death his papers were placed in the hands of Baily, who gave an account of his work in the seventh volume of the *Memoirs* of the Royal Astronomical Society

"BIOLOGY and Statecraft" formed the subject of a national lecture broadcast by Sir Walter Morley Fletcher on Jan 23 Sir Walter briefly epitomised the historical developments in biology, and emphasised the sudden speeding up of this development within the memory of living man Reasons were given for this sudden increase in speed of development, the chief two being the invention of the microscope and the use of experiment The latter, we think, forms the most important explanation of all Microscopy has just followed a serene type of development since its inception in the seventeenth century On the other hand, experimental biology, such as physiology, and the chemical aspects of mycology, entomology, and so on, are of much more recent development It was entomology, a comparatively recent science, that received Sir Walter's attention, based on his statement that insects are still our most destructive enemies and rivals Such insects will have to fight hard with pathological bacteria in order to retain this distinction As Sir Walter pointed out, the study of entomology should receive more recognition by the State There are only 275 official entomologists in the British Empire, and we spend only a quarter of the amount that the United States of America spend on this science It is difficult to ascribe this dearth of entomologists to any one factor We must not blame completely, as Sir Walter suggests, the lacking in scientific knowledge by our statesmen and those in administrative authority, for they are now offering great facilities for the training of entomologists, but, we believe, the root of the trouble is that such opportunities for training, offered by the State, have not yet been appreciated by men students Nevertheless, as we have often remarked, science must not become the tool of the State, but must always remain the concern of the State, and then, as Sir Walter said of biology, we shall be able to bring into our methods of statecraft the guidance of biological truth

THE Representation of the People Bill, which has recently been issued, includes a clause providing for the total abolition of university constituencies These constituencies were originated at the beginning of the seventeenth century by James I with the object of enabling universities to send grave and learned representatives to parliament As, however, men of scholarship are not now segregated and confined solely to universities, these constituencies were threatened with extinction just before the War, though, since then, as stated in a leading article in NATURE of Nov 4, 1922, they have become enhanced in prestige and extended application It is on this

latter observation that the case for the retention of university constituencies should be based At the same time, some type of legislative reform is clearly necessary, if only to take account of modern developments of universities In view of this progress, the present method of university representation is distinctly old-fashioned and undesirable Plural representation of the older universities seems unnecessary, and a fuller representation of the newer universities is worthy of consideration The list of voters in 1929, which appears in the memorandum upon university representation submitted to the electors of the older universities, the substance of which appears on p 183, supports this view However this may be, the proposal to abolish university constituencies altogether must raise strong protests from members of all parties

THE university of to day is not merely a collection of books as Carlyle suggested, neither is it just a place of advanced lectures followed by examinations and ultimately a degree At one time, it was, but now it is the head of, the power behind, the whole of our great system of education, without putting itself as the 'be all and end all' of everyone who is being educated In more ways than one it influences all primary and secondary education, and has thus become a great, comprehensive entity Although we have a Board of Education with its specially appointed advisory councils and committees, representatives of universities—that is, representatives of our complete educational system, from five to twenty five—are clearly desirable in Parliament, to safeguard and advertise the aims and projects of one of the most essential features of our modern constitution It is therefore a little surprising that a measure to abolish direct academic representation should be brought forward at the present time, and especially by a government which has shown genuine concern for the development of educational work of all types

ALTHOUGH we have as yet in the British Isles no professedly and distinctively Children's Museum on the lines of the many now existing in the United States, still the movement here is progressing Indeed, under the curatorship of Miss Beatrice Hindshaw, the Horsfall Art Museum in Ancoats, Manchester, is already in practice, if not in theory, a museum for the boys and girls of that otherwise poor district In the Liverpool Museum, Dr Allan has been furnishing a Children's Corner, and the boys, if not the girls also, of London are eagerly awaiting the treat promised them by Sir Henry Lyons at the Science Museum These are notable instances of what is being done, but the museum founded for children alone is yet unborn It is, however, in embryo A meeting held in London a few months ago decided "to found a Children's Museum in London, to be a national and international centre, to educate and inspire the children of all races, and to stimulate child-lovers of the British Empire and the World"

To judge from the printed statement, the promoters of the Children's Museum base their museum idea on the child's world as it appears to the child, or as it might more happily appear, rather than on the world of the adult, to which the museum should gently introduce the child Stress seems to be laid on such objects as toys, pictures, and models, and on such methods as marionettes, a children's orchestra, theatre, dance hall, and fairy tale rooms More serious subjects are not definitely excluded, but science and natural history might well bulk more largely in the programme These schemes, however, have a habit of growing according to circumstances rather than plan The important thing is to make a start in a house (or room) with some energetic curators (or even one only), and the gifts for which the distinguished supporters appeal will then flow in The honorary temporary secretary is Mrs Chas E Dawson, 8 Queen's Gardens, Lancaster Gate, London, W 2

AT a meeting of the Ross Institute Industrial Anti Malarial Advisory Committee in December last, reports were received on anti malarial work carried out in various tropical countries Dr G C Ramsay stated that in tea gardens in Assam he had been able to exclude hookworm disease and kala azar as chief sources of sickness among the coolies The principal cause of sickness, inefficiency, and death was malaria, and the contrast between the malarial and the non malarial gardens was extraordinary Mosquito control consisted, in the first place, in studying those species in a district which carried malaria, and their habits, and then taking measures directed especially against those species In his own district, Dr Ramsay found twenty species of anopheline mosquitoes present, but an intensive study proved that practically only one (*A minimus*) carried infection The value and application of larvicides, oiling, and Paris green as anti mosquito agents were described, and examples given of immediate improvement following their use Biological methods were also employed, such as encouraging the growth of certain swamp plants and destroying others Sir Malcolm Watson, principal of the Malaria Department, Ross Institute, confirmed Dr Ramsay's results He stressed the value of quinine in the treatment of malaria, provided it was used in sufficient doses over a sufficient period Plasmoquine might be a valuable adjunct to quinine, for it was claimed that this drug killed the sexual forms of the malaria parasite, which are those that infect the mosquito He pointed out that investigation is required to explain why some anopheline mosquitoes carry malaria and others do not, and why a particular species may carry malaria in one country and not in another

MR NICOLAUS, of the Selection Trust, speaking of the Rhodesian Copper Mines, stated that since the Ross Institute expedition to Northern Rhodesia the incidence of malaria at one mine had dropped from 27 per cent of population per month to only 8 cases per month in a population of between 8000 and 9000 At another mine, with a population of between 10,000 and 11,000, since mosquito control had been inaugurated, the malaria incidence last October was nine new cases only The Tata Iron and Steel Company have also adopted a scheme of mosquito control,

drawn up by Sir Malcolm Watson, and report that the Noamundi Mine is now entirely free from both larval and adult anophelines, and that no new cases of malaria have occurred for some time The Burma Shell Group is to join with the Ross Institute in an investigation of the oils available in India for oiling mosquito-breeding waters, so that the oil most suitable for any place in cold or in hot weather may be selected The Ross Institute Industrial Anti-Malarial Advisory Committee was formed in 1928 to keep industry in touch with science, to make the tropics healthy, and expand the markets of the world It consists of representative members of industry and members of the Ross Institute The Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S W 15, is entirely supported by voluntary contributions

THE annual general meeting of the Royal Meteorological Society was held on Jan 21, when Mr R G K Lempfert was re elected president The Buchan Prize, which is awarded biennially for the most important original papers contributed to the Society during the previous five years, was presented to Dr C E P Brooks Mr R G K Lempfert delivered an address on the work of the Meteorological Office at the Royal Airship Works, Cardington, of which Mr M A Giblett, who lost his life in the disaster to the *R101*, was in charge The weather charts constructed from all available material for the study of the conditions over the area between Great Britain and India were described The greater part of the address was, however, devoted to describing the experimental investigation of atmospheric turbulence which is still in progress Four anemometer stations have been set up at Cardington, separated from one another by distances of about 700 feet Each station is equipped for recording the direction and velocity of the wind on a very open time scale, so that the variations of wind from second to second can be examined Comparison of these detailed records from the four stations will furnish important information regarding the extent and intensity of the eddies which are always present in the wind The importance of the eddying character of the air movement which we call wind is being more and more recognised in the science of meteorology The stresses and strains to which structures are exposed during gales are due to the eddies Fog formation equally depends on eddy motion, though on a different scale, so does the distribution of atmospheric pollution Closely associated with the details of wind structure is the distribution of temperature in the vertical, and the arrangements made at Cardington, and also at Ismailia, for keeping this important meteorological factor under constant observation up to a level of 200 feet were described

AN important feature of the work of the enlarged Rubber Service Laboratory of Imperial Chemical Industries, Ltd , opened at Blackley on Jan 22, is that devoted to rubber service for users of Vulcafor products, and is intended to assist rubber manufacturers in the solution of problems which arise in connexion with the use of accelerators, anti-agers, pigments, and other products; but research work represents one of its chief activities Such research work includes studies on the new rubber substitutes, etc , prepared by the treatment, polymerisation, and so forth, of vegetable oils and other organic compounds, with the object of developing new products for use in the rubber industry, also investigations aiming at the discovery of vulcanisation accelerators, anti-agers or anti oxidants, anti-scorching compounds, etc , of improved properties, intended to increase the life of rubber articles During the last few years, for example, the mileage life of a motor tyre has been increased from the order of 5000 to nearly 20,000 Other research is concerned with the properties of various rubber compounds and the development of improved methods of physical and chemical testing The laboratory is a normal development of the British dyestuffs industry, with the other research laboratories of which it is in close collaboration The enlarged laboratory is the most completely equipped of its type outside the United States of America

IN one of his series of popular meteorological articles entitled "Why the Weather", issued by Science Service, Washington, D C , Prof C F Talman directs attention to important advances in travelling comfort introduced in recent years in the United States On certain steamers that navigate tropical waters, and later on certain railway lines crossing very hot desert regions, arrangements for controlling the temperature and humidity of the air in saloons and restaurants have been successfully introduced Experiments on these lines must lead to increased knowledge of the effect of various atmospheric conditions on human comfort, and it is to be hoped that they will result eventually in the carrying out of an important climatological inquiry A vast amount of information has been accumulated about the temperature, humidity, wind, etc , in different parts of the world, but anyone confronted with statistics of this kind is apt to be misled as to the extent to which any very abnormal temperatures are likely to give rise to discomfort, through inability to make a proper allowance for the other factors What is required is some system of reducing ordinary air temperatures to what might be called 'virtual temperatures', so that the regions of greatest physiological heat and cold could be shown on climatological maps It is recognised that the 'wet bulb' thermometer is superior to the ordinary 'dry bulb' in this respect, but something more representative of human sensations than even the wet bulb is required There is, for example, the difference of sensation between cloudy and clear weather, due to radiation effects, that should be taken into account Meteorological statistics would clearly be rendered of very much greater practical value if work on these lines could be successfully carried out on a world-wide scale

SIR WILLIAM BRAGG's Friday evening discourse on Jan 23, at the Royal Institution, on "The Scattering of Light", was the first to be given in the reconstructed theatre of the Royal Institution The subject of Sir William Bragg's discourse had a historical connexion with the Institution In its earliest form it asked

for explanations of the blue of the sky and sea Prof Tyndall and the late Lord Rayleigh were among the earliest and most important contributors to the solution of the problem Rayleigh put the theory on a sound basis, and explained exactly why the blue is scattered more than the red, so that it was turned aside while the red passed on The same explanation was applicable to the colours of the rising and setting sun Rayleigh showed also that there was no need to postulate the presence of water vapour the molecules of the air itself were sufficient to explain the amount of the scattering In recent years the interest of the subject has been greatly increased by the discoveries of Sir C V Raman, of Calcutta He has shown that there is a form of scattering hitherto not observed Some of the original light is scattered with change of colour, and this change is capable of the most precise measurement Many workers in various parts of the world have extended Raman's discovery and a new and most fascinating field of research has been opened up The change mentioned depends on the nature of the scattering atoms and molecules, the properties of which are thereby made capable of closer observation Moreover, the explanations of the new effects are more easily expressed in terms of the quantum or corpuscular theory of light, and in this way the highly attractive mystery of the nature of light is still further enhanced

THE Annual Report of the Director of the U S Bureau of Standards (Dr G K Burgess) to the Secretary of Commerce for the year ending June 30, 1930, is a pamphlet of 53 pages which gives a short account of each section of the work of the Bureau The staff numbers 1161, the average salary is £490, and the total expenses for the year £588,000, an increase of £37,000 on last year The largest item, £54,000, is for tests of building materials, the next, £44,000, for standardisation of the products of industry, and this work seems so much appreciated by the manufacturers that between 80 and 90 per cent of them are carrying out the recommendations of the Bureau in respect of between seventy and eighty commodities Industrial research has cost the Bureau £41,000, but forty-one associations and manufacturers co operate with the Bureau and maintain ninety six research associates, eleven of whom work at the Bureau on radio and electrical problems, eight on cements, eight on petroleum and its products, seven on fuel, and seven on steam and high temperatures The fee value of the tests carried out at the Bureau was £137,000 The present buildings are greatly over crowded and a five year building plan has been submitted to Congress

SOME interesting particulars of the activities of the Bureau of American Ethnology are given in the recently issued forty-fifth Annual Report, which covers the period 1927–28 Miss Densmore has made additional studies of the music of the American Indian, both in the field and in the laboratory Her remarkable collection of phonograph records now amounts to 1695 Study of the Columbia Basin and Lower Snake River in Oregon by Mr N W Kreiger has revealed a uniform culture, with some remarkably clearly defined localised specialisations in tools and art designs It is expected that further investigation will show the relation between the culture of this area and the pre agricultural south west In two areas in particular the work of the staff of the Bureau requires mention In the south western States the investigation of the Basket maker and Pueblo cultures is producing some of the most notable results in American archæology In Alaska, Mr Henry B Collings, jun , and Mr T Dale Stewart, conducting investigations at Nunivak Island and along the adjacent coast, have found what is held to be the most primitive of all the Alaskan Eskimo Among the "Accompanying Papers" two important contributions, dealing respectively with the Salishan tribes of the Western Plateaux and the Thompson Indians, are edited by Prof Boas from the papers of Mr James Teit, whose intimate knowledge of the Thompson Indians was based on a residence among them of many years It is interesting to note that Dr La Flèsche's record of an Osage war ritual was written down at the request of the Indians themselves to ensure correct rendering of the ritual at the next performance The request is significant as indicating a desire to keep up old customs, which is losing ground in a struggle against the weakening of tribal memory

THE Department of Zoology of the British Museum (Natural History) has recently received, as a donation from His Royal Highness the Duke of Gloucester, the skin and skull of a Menelik's bushbuck (*Tragelaphus scriptus meneliki*), and from Mr A S Vernay, a large collection of antelopes and other big game from Bechuanaland Recent donations from the Trustees of the Rowland Ward Bequest include a ratel, or 'honey badger' (*Mellivora ratel*), from Kenya Colony The ratel is found over a great part of Africa south of the desert region and in many parts of India The fore-limbs carry very large and powerful claws, which are used by the animal for burrowing Although a comparatively common animal, it is, owing to its nocturnal habits, but rarely met with, living amongst rocks or the roots of trees Ratels are practically omnivorous, feeding on honey, a variety of fruits, snakes, and sometimes raiding poultry farms They can attack bees' nests with impunity, as the great thickness of the skin prevents any serious harm being done by the bees' stings The Museum has also received a collection of more than 7000 specimens of land shells from Lord Howe Island and Norfolk Island , the land snails of these isolated islands are of importance for the study of geographical distribution, The Department of Botany has purchased the *Transactions* (in manuscript) of the Society of Amateur Botanists, in two volumes, 1863–64, from the library of Sir George Watt The Society was formed among the old students of M C Cooke's evening classes in botany, for artisans, held at Trinity Schools, Lambeth, where Cooke was head master Many others joined who afterwards became eminent botanists, including J Britten, W Thiselton Dyer, Berthold Seeman, Worthington G Smith, and Henry Trimen The meetings were held first same

Metropolitan Club Edgware Road, and then over Robert Hardwicke's shop in Piccadilly Hardwicke's *Science Gossip* was one result, another was the formation of the Quekett Microscopical Club, which replaced the Society in 1865

SIR WILLIAM BRAGG, Fullerian professor of chemistry in the Royal Institution, has been elected an honorary member of the Institution of Electrical Engineers

IT is announced in *Science* that Dr David White, senior geologist of the U S Geological Survey and home secretary of the National Academy of Sciences, was awarded the Penrose Medal at the Toronto meeting of the Society of Economic Geologists

THE one thousand dollar award of the American Association for the Advancement of Science for an outstanding paper presented at the recent Cleveland meeting was given to Drs M A Tuve, L R Hafstad, and O Dahl, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington Their paper entitled "Experiments with High Voltage Tubes" was presented to the American Physical Society

THE Society for Cultural Relations with Soviet Russia is considering the possibility of organising a tour of scientific institutes in Soviet Russia during July and August 1931 It is proposed to arrange for parties of British scientific workers engaged in physical, biological, and medical research to visit and meet Russian workers engaged in similar researches V O K S, the central institution in Moscow for organising cultural relations with foreign countries, is prepared to do everything possible to help the tour, and Intourist, the Soviet organisation for tourist parties, will consider giving specially reduced travelling charges Scientific workers desirous of joining such a tour are invited to write to the Secretary, Society for Cultural Relations with Russia, 1 Montague Street, London, W C 1

WHEN the late Sir Patrick Manson was addressing the Section of Tropical Diseases at the annual meeting of the British Medical Association in 1898, he said that there was not one of his hearers who did not bewail the crass ignorance in which he had lightly undertaken the care of men's lives in dangerous climates, nor one who could not pillory himself with the recollection of lives that perished owing entirely to the lack on his part of an elementary knowledge of tropical medicine Manson's address came under the notice of Joseph Chamberlain, who took action which resulted in the establishment of the London School of Tropical Medicine From that School, which Manson himself directed, and its successor, the London School of Hygiene and Tropical Medicine, some 4000 medical officers have gone to the far corners of the earth, trained in special post graduate courses in tropical medicine At the School on Feb 3, 1931, Dr Philip Manson Bahr will deliver a public lecture on "The Dawn of Tropical Medicine, being an account of the Life and Work of Sir Patrick Manson" The chair will be taken by Sir Harry Goschen, Bart, and admission is free, without ticket

THE Ministry of Agriculture and Fisheries has recently issued two advisory leaflets, one on "Swine Erysipelas" (No 17), another on "Blackhead of Turkeys" (No 20) Information is given on the symptoms, recognition, treatment, and modes of prevention of these diseases

The annual "Guide to the Spas and Marine Health Resorts of Great Britain and Ireland and New Zealand", by Dr R Fortescue Fox, has recently been issued (London J and A Churchill, 1s net) Information is given on the climates of coastal resorts and inland spas, with indications regarding the ailments for which they are best suited

THE "South African Journal of Science", vol 27, which is the report of the South African Association for the Advancement of Science, has just been published by the Association at Johannesburg, price 30s net The volume contains a statement of the constitution of the Association, the presidential addresses, and a complete collection of the papers read and published An account of the meeting, including brief notes on some of the papers, appeared in NATURE of Nov 29, p 862

A SECOND edition of the economic pamphlet No 112, entitled "The Cockroach its Life history and how to deal with it", by Mr F Laing, has recently been issued by the British Museum (Natural History) It provides a general account of the commoner species of these insects that frequent buildings, etc, and discusses means of their eradication This pamphlet will be found useful by anyone troubled with these pests, and is obtainable at the Museum in Cromwell Road, or through a bookseller, price 6*d* (postage 1*d*)

THE Departmental Committee on Maternal Mortality and Morbidity in an interim report which was published last July found that not less than one-half of maternal deaths in childbirth are preventable under suitable conditions The Ministry of Health has now issued a memorandum (*Memo* 156/M C W) with explanatory Circular (1167) to local authorities, directing their attention to this report, and urging them to exercise their full powers for the care of maternity Authorities are reminded that an additional amount of £5,000,000 for the development of the maternity and child welfare services was included in the general Exchequer contribution under the Local Government Act, 1929

DR EDWARD R WEIDLEIN, Director of the Mellon Institute of Industrial Research, announces that the Institute has lately begun a broad investigation into possible industrial uses for raw and refined sugar The research will be carried on by a multiple industrial fellowship sustained by the Sugar Institute, Inc, of New York, an organisation that represents the cane sugar refiners of the United States The investigation will be supervised by Dr George D Beal, assistant director of Mellon Institute, and by Dr Gerald J Cox, Senior Industrial Fellow Four chemists have begun the initial scientific research of the industrial fellowship, and additions will be made to this staff, as needed, from time to time

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant lecturer in phonetics at the Glasgow Training Centre of the National Committee for the Training of Teachers—The Director of Studies, Training Centre, Jordanhill, Glasgow (Feb 2) A graduate in engineering for physics, mechanics, mathematics and machine drawing at the Southall Technical Institute—The Principal, Southall Technical College, Southall, Middlesex (Feb 2) A junior demonstrator in physiology at the University of Durham College of Medicine—The Registrar, College of Medicine, Newcastle upon-Tyne (Feb 2) A laboratory assistant in the Bacteriological and Pathological Laboratory, Birkenhead—The Town Clerk, Town Hall, Birkenhead (Feb 6) A principal of the High Wycombe Technical Institute—The Secretary for Education, Education Department, County Offices, Aylesbury (Feb 7) A head of the engineering department of the Leicester College of Technology—The Registrar, College of Technology, Leicester (Feb 21) An assistant in the London Museum—The Keeper, London Museum, St James's, S W 1 (Mar 14) An entomologist under the Indian Research Fund Association, able to undertake independent inquiries on malaria in the field or laboratory—The Secretary, Indian Research Fund Association, Simla, India (Mar 31) A woman lecturer in geography at the Warrington Training College, Liverpool—The Principal, Warrington Training College, Wavertree, Liverpool A full time teacher of draughtsmanship (engineering), under the London County Council—The Education Officer (S S 5), the County Hall, Westminster Bridge, S E 1

Our Astronomical Column

Light-Variation of Eros —*Beob Zirk*, No 3, contains some observations of maxima and minima of Eros, made at Hamburg-Grossborstel by M Beyer The principal period is still $5^h\ 16^m\ 14^s$, but the light range is notably smaller than it was at the beginning of December Similar changes of light range have been observed at other apparitions, they favour the theory that the planet is double, and that mutual occultations occur when the earth is near the plane of rotation, but not otherwise Duplicity ought to be detected by the great American telescopes at this near approach, if it exists Prof Yamamoto notes in *I A U Circ*, No 309, that even if the variation arises from regions of very different albedo on the planet's surface, it may cause the centre of light to be shifted some 0 1" from the centre of figure, which would be an appreciable amount in researches of such delicacy as are now being carried out There was a request to observers with large instruments to try to observe the shape of the planet, but no reports have yet been received on the subject

Locating the Sun's Corona —In *Comptes Rendus* for Nov 10, M Lyot, of the Meudon Observatory, describes work conducted by him during July and August last, at the observatory of the Pic du Midi, for detecting the sun's corona without the unique conditions afforded by a total solar eclipse M Lyot states that from his observing station the purity of the atmosphere was such that, by the interposition, in the optical train, of a metal disc slightly larger than the image of the sun formed by a 4 cm objective, the prominences at the sun's limbs were clearly visible without recourse to a spectroscope Working under these conditions with a very sensitive polariscope, he explored the sky immediately surrounding the sun's disc It was found that the proportion of polarised light (the plane of which appeared to be radial) was insensible at about 6′ from the sun's limbs but increased inwards M Lyot proved to his satisfaction that the origin of the polarisation was neither atmospheric nor instrumental, and he concludes that he has observed the polarisation of the sun's inner corona Figures for July 29 and 31 derived from the observations made at various position angles at a constant distance of 80" from the sun's limbs show two minima that correspond to the position of the sun's axis on those days A further substantiation was made by observing the strength and length of two bright lines of the spectrum that were visible with a direct vision spectroscope These lines were evidently the coronal lines λ5303 and λ6374, and their variation at different position angles around the disc corresponded generally with the degree of polarisation observed These results are of great interest, for they indicate a means of studying frequently certain attributes of the sun's corona that have hitherto been available to observation during the brief and infrequent occasions of a solar eclipse

Rotation of the Galaxy —Sir Arthur Eddington chose this topic as the subject for the Halley Lecture on May 30, which has been published at Oxford by the Clarendon Press After a brief historical sketch, he gives a proof of the formula published by Dr Oort a few years ago, which states that the radial velocities of the stars contain a term varying as twice the sine of their galactic longitude, this being measured from the centre of galactic rotation He notes that the same formula was published by Gylden in 1871 but did not then attract much attention

The formula gives two alternative positions for the galactic centre, diametrically opposite to each other The one in Sagittarius is now selected, on other grounds, but Gylden chose the one in Gemini Prof Turner had also been led to the position in Gemini by consideration of the two stellar drifts, but that method likewise gave two opposite positions as possible Dr Plaskett, in the George Darwin Lecture of the Royal Astronomical Society delivered last May, showed that the radial velocities of the stars of types *O* and *B* supported Oort's position of the centre, and further indicated that the interstellar gas shares the rotation of the stars Sir Arthur Eddington notes that, owing to the viscosity of this gas, it does not appear that its rotation could be maintained indefinitely, this tends to support the shorter time scale that limits the duration of the stellar system to a few thousands of millions of years, whereas the long scale gives millions of millions

Galactic rotation gives an explanation of the fact that the quick moving stars are all moving towards one hemisphere, those are really the laggards, and the sun is moving from them, not they from the sun Stars with high speed in the rotational direction would escape from the galaxy, the attraction of which could not control them They have already been eliminated Sir Arthur Eddington notes that the aspect of the spiral nebulæ is far from suggesting stability As our galaxy is believed to resemble them, this consideration also favours the shorter time scale The rapid recession of the spirals, if taken as real, is shown to provide an argument tending in the same direction

Research Items.

The Klamath—In 1925 and 1926 Mr Leslie Spier visited the Klamath of southern Oregon to study their religion and social organisation, now a thing of the past, but of which the memory still exists among some of the elder people who still occupy their old home The results of the investigation are published as vol 30 of the *University of California Publications in American Archæology and Ethnology* The Klamath are the northern of two major dialectic groups of the Lutuami linguistic stock, of which the southern is the Modoc The Klamath have the richer and more specialised culture They were first visited by whites in 1825 and 1826, at a time when the Snake Indian raids were at their height These raids probably account for the fact that country between the Klamath and the Dalles on Columbia river was unoccupied It is probable that in historic times their highest number was about 1200 Owing to lack of adequate information relating to the tribes of the region, it is difficult to place the Klamath in relation to surrounding cultures Their food habits and material culture generally follow the plateau peoples Although their river the Williamson river—was a minor stream, they are as much a river people as the Thompson, Lilloet, and Sushwap Their staple food was fish, supplemented by roots and seeds Deer and other game, though abundant, was not hunted Their mode of living was arbitrary and not decided by geographical conditions Klamath and Modoc represent the southern boundary of the plateau culture but they have a strong leaning toward north eastern California The basis of their religious experience is that of the northern interior the Columbia basin, and the north west coast Specifically the resemblance appears in the circumscription of spirit possession to the mid winter month Details of shamanism on the other hand link with north eastern California Social organisation is simple and like that of the basin and plateau in every particular

Tuberculosis in Man and Lower Animals—The material for an important memoir under this title by Dr H H Scott (*Medical Research Council, Spec Rep Series* No 149 H M Stationery Office, 4s net) is derived from post mortem examinations made by Dr Scott of 300 cases of fatal tuberculosis occurring among Chinese of the labouring class in Hong Kong, and from similar examinations of a series of wild animals dying of tuberculosis while in captivity in the Zoological Gardens, London He also reports upon some cases of mycosis in animals, the lesions of which are not unlike those of tuberculosis Interesting details are given of the kind of lesions and their distribution and histology in the various animals Thus in the dog, whitish circumscribed tumours with viscid or mucopurulent centres occur in the lungs, liver, and kidneys, which in their naked eye appearances simulate cancerous growths Microscopically, the tubercle of the dog differs from that found in man and most other mammals by the absence of giant cells In the parrot, which is susceptible to both the human and the avian types of the bacillus, pulmonary tuberculosis is rare and cutaneous infection is common, taking the form of lupoid or warty affections of the head Tuberculosis is of exceptional occurrence in cold blooded animals and the bacilli are of several types Lesions may be present in the lungs, liver, and intestine, and occasionally as a cutaneous infection Mycoses are commoner in birds than in mammals and double infection with tuberculosis is not infrequent. Dr Scott doubts the occurrence of tuberculosis in animals in the wild state

Musk-Ox in Sub-Arctic Canada—In continuing the account of his expedition to sub arctic Canada, to which we have already referred, Capt J C Critchell Bullock discusses the habits of the musk ox (*Canadian Field Naturalist*, Nov 1930, p 187) He does not agree with the notion that the musk ox is a migratory animal It is gregarious, and the band may indeed make periodical journeys, but these are usually due to lack of food in the northern haunts, where grass and willows do not grow so profusely as towards the southern limit of their range Apart from such movements, they prefer to associate themselves with a chosen locality, where they remain indefinitely Nor does the author agree with the report of the Royal Commission of 1922 upon the musk ox, as regards feeding habits Instead of showing preference for grass as compared with willows, moss, and lichens, as the report suggests, the musk oxen of the Thelon district were only once seen to eat grass where young shoots of willow bushes were available The species has been practically exterminated about the head waters of the Coppermine and Black's Rivers, and the evidence suggests that the policy of conservation is not resulting in the increased numbers hoped for In the musk ox country there were fewer signs of wolves than anywhere else, but it is possible that the grizzly bear may do some damage, though the likelihood is that the inland Eskimo has more to do with the reduction of a species which may still be said to be in no little danger of extermination A good omen, however was the observation of Capt Critchell Bullock that calves composed almost one third of the three bands he saw

Hydatid Disease This disease is a condition caused by the developmental stage of a tape worm which has its natural habitat in the intestine of the dog and occasionally in other carnivora The cystic or developmental stage is particularly met with in the sheep and in man, it is usually those who come in contact with sheep who develop the disease The disease is apparently rare in China and Dr H H Loucks, Department of Surgery Peiping Union Medical College, in a paper entitled 'Hydatid Cyst', reprinted from the *National Medical Journal of China*, vol 16, pp 402 496 1930 has been able to collect only twenty cases recorded in the literature, but during the last ten years he has been able to add twelve more undoubted cases, and five others in which a diagnosis rested upon clinical evidence only Full details of the cases, with a review of the literature on Chinese cases and a bibliography, are given

***Holacanthus bispinosus* in the Philippines** - Mr Heraclio R Montalban, of the Division of Fisheries Bureau of Science Manila, records this handsome fish for the first time from the Philippines ('A Chaetodont new to the Philippines", *Philippine Journal of Science*, vol 41, No 3, March 1930) and re describes it with a good coloured figure The description is taken from two specimens, 78 5 mm and 81 mm in length, from Lumbian Islands, Sulu Archipelago Previous records are from Zanzibar Amboina, New Hebrides, Tahiti, Samoa, and the Hawaiian Islands The fish bears some resemblance to *Holacanthus multispinis* Playfair, but is distinguished at once from the latter by the absence of a shoulder blotch

Fauna of Lancashire and Cheshire—An interleaved check list of the fauna of Lancashire and Cheshire ("A Check List of the Fauna of Lancashire and Cheshire', pt 1 Arbroath T Buncle and Co

5s. net) has been edited with great care by the secretary of the Fauna Committee of these two counties, Mr A K Lawson, and has a preface from the pen of Prof W M Tattersall, of University College, Cardiff Twenty two orders, ranging from Mammalia to Oligochæta, are included, and the number of insects, spiders, birds, fishes, mites, mammals, worms, and other creatures amounts to upwards of four thousand Mr Coward is responsible for the Mammalia (50 species), Aves (288), Reptilia and Amphibia (both 6 species), and non marine Pisces (32) Of ants Mr Donisthorpe records 27 forms, there are 1920 Coleoptera, 414 Hemiptera in two almost equal divisions, and 157 Tenthredinidæ classified by Mr Britten Mr Lucas deals with the Mecoptera (3) Neuroptera (28) Paraneuroptera (23), and Orthoptera (34) There are 22 species of Siphonaptera and no fewer than 467 Arachnida The latter, together with the Opiliones (15 species) and Pseudoscopiones (14), are treated by Mr Falconer, who, together with the Rev J E Hull, is responsible for the Acari (345 species) Prof Tattersall and Mr Britten record a hundred and one Crustacea, Dr Wilfrid Jackson 143 Mollusca, and the Rev Hilderic Friend 42 Oligochæta, or land and fresh water worms, with nine different parasites found in the same Few counties can show so large a record, which is a testimony to the industry of the members of the county natural history societies and the recorders

Use of Compost for Turf – The use of compost in horticulture is nothing novel but it has been little employed for the improvement of turf A series of articles in the *Journal of the Board of Greenkeeping Research* vol 1, No 3 shows how it may be applied to golf greenkeeping The preparation and usage of compost is dealt with by R B Dawson The term is applied to a mixture of soil and organic material piled up in alternate layers and allowed to rot Heavy clay or pure sand should be avoided and horse stable manure is the most favoured type of organic matter, but peat moss leaves grass cuttings spent hops and seaweed are also mentioned as satisfactory The stack must be protected from rain, both to facilitate subsequent sieving and also to prevent putrefaction and loss of valuable fertilising materials A compost heap is best started in the spring and should be allowed to stand undisturbed for one or preferably two years before use, February and March being the best season for treating the turf The American system is to apply one ton (1 cub yd) of screened compost per month per 5000 sq ft usually accompanied with 10 25 lb sulphate of ammonia However, considerable benefit is obtained with smaller quantities and an application of one ton in the spring followed by monthly dressings of 5 10 cwt , to which sulphate of ammonia and sulphate of iron have been added for weed destruction, is suggested The chief objections against the use of compost are based on the possible introduction of weeds This difficulty can be entirely overcome by sterilising the compost before use, and practical details of the plant in use at the Malone Golf Club Belfast, are described by J Henderson Baking appears to be the best method of procedure and the cost of 1s 6d per ton is not considered prohibitive The advantages from the use of compost are various It tends to level the turf and encourages bottom growth of grass, it acts as a valuable carrier for the distribution of fertilisers, itself supplying humus and small amounts of plant food, and also exerts a protective action under conditions of drought or frost

Huygens and other Lens Makers of the Seventeenth Century – The addresses delivered by Dr P Zeeman, Prof Picard, and others in the hall of the Academy of Sciences at Leyden in celebration of the tercentenary of the birth of Christian Huygens on April 14, 1629, have been issued in pamphlet form by Paris of Amsterdam, along with Dr C A Crommelin's guide to the exhibit of Hugeniana in the Observatory, illustrations of apparatus three portraits of Huygens, and a view of his home during a considerable part of his life in Holland In a further pamphlet by the same publisher, Dr Crommelin gives an account of the lens makers of the seventeenth century, with portraits and figures of their grinding apparatus Although Descartes invented a grinding machine, he does not appear to have made lenses Huygens and his brother Constantin began to grind lenses in 1655, and illustrations of their machines are given as well as those of Hooke Hevelius Maignan, and several taken from Zahn s ' Oculus artificialis' of 1685 Gutschoven Calthof, Mocchi, Reeves Campani Divini, Hartsoeker Spinoza, Leeuwenhoeck and Le Bas are all mentioned as lens makers, but no details of their methods are given Dr Crommelin s pamphlet forms a valuable addition to the papers of von Rohr and Baxendall which have appeared recently in the *Transactions* of the Optical Society

Interaction of α-Particles and Helium Nuclei – It has recently been shown by Dr J Chadwick that the collisions between α particles of medium speed and helium nuclei do not follow the law of the original theory of scattering but that they behave instead in a modified way because of interference between the material waves of the two similar particles Dr Chadwick s results were taken to as small velocities of the particles as were conveniently studied by the scintillation method P M S Blackett and F C Champion, in an investigation with a Wilson cloud apparatus described in the January number of the *Proceedings of the Royal Society* have now carried these further and again obtained good agreement between their measurements of forks on α particle trails at the end of the range in helium and the predictions of the wave mechanics The statistical element in this work is more important than in Dr Chadwick s in spite of the fact that trails of about 50 000 α particles from polonium were examined, but the agreement remains on the whole very satisfactory A new result of importance which has been obtained incidentally in connexion with the present work is the relation between the speed of very slow α particles and the residual range in air under standard conditions

Isotopes of Zinc, Tin, Chromium, and Molybdenum A description of the isotopes of these four elements which have been successfully studied by the introduction of volatile methyl compounds and carbonyls into the apparatus, is given by Dr F W Aston in the January number of the *Proceedings of the Royal Society* In the case of zinc and tin the order of intensity of the isotopes has been revised and with the other metals new isotopes have been discovered In all cases, very good agreement is found between the chemical atomic weight, as deduced from the masses and relative abundance of the various isotopes, and that obtained by the more usual direct chemical methods The actual numbers for these constants from mass spectrograph data are $Zn-65\ 38_0 \pm 0\ 02$, $Sn\ 118\ 72 \pm 0\ 03$, $Cr\ 52\ 001 \pm 0\ 006$, and $Mo-95\ 97 \pm 0\ 06$ Dr Aston has not been able to obtain new results for cadmium and germanium Cadmium methyl, although chemically similar to zinc methyl, behaved in a totally different way in the discharge, cadmium depositing on the walls and disturbing seriously the normal beam of

rays Germanium was studied by germanium ethyl, by use of which it had already been shown that there are eight isotopes to this element, but no satisfactory quantitative results were obtained Dr Aston proposes to study germanium later with the methyl compound, but it appears that with cadmium it will be necessary to return to the more difficult technique of 'anode rays', by which its isotopes were first discovered

Beam 'Arrays' in Short-Wave Transmissions—During the last three years the technique of short wave transmission of electric waves through space has been rapidly developing It is interesting to remember that so far back as 1899, S G Brown took out a patent for an aerial which utilised the principles of interference now commonly adopted The first successful high speed radio telegraph service was inaugurated at Bodmin, Cornwall, in 1927 by Franklin and Marconi They developed a method of short wave generation, which enabled engineers to design transmitters able to supply a large output at a steady frequency The transmitters used in short wave transmission are 'arrays' of wires scientifically spaced and carrying currents in the correct phases so as to increase greatly the resultant field strength in a definite direction In a paper read to the Institution of Electrical Engineers on Dec 3, T Walmsley described many of the beam 'arrays' which are used in different countries, and in particular his own 'T W' aerial array which is used at the Post Office radio station at Rugby He pointed out that the question of suitable transmission lines to the 'array' is of great importance The Marconi beam stations, the French and the German stations, all use concentric tube transmission lines Mr Walmsley, however, pointed out that the losses in open circuit lines are much less than most engineers think, and so they can in many cases be usefully employed Provided that the currents in the lines are well balanced, the radiation losses are small There are losses in open circuit lines due to the 'high frequency' resistance, the proximity of the wires, the dielectric losses in the insulators, and the reflections from points on the circuit where the electrical constants change He suggested methods for reducing these losses

Problems in Lighting Systems—Dr W T Walsh, of the National Physical Laboratory, has contributed an interesting paper on photometric research to *World Power* for January In considering the merits of any lighting system it is necessary to take 'glare' into account It is found that the sensitivity of the eye is diminished four fold if a light source of sixty candles is placed 10 feet from the observer, when the line joining the source to the eye makes an angle of 3° with the line of sight The rate at which the eye loses sensitivity when a light suddenly appears and the rate at which it recovers when the glare is removed are being investigated There is at Teddington a model street, 500 feet long and 35 feet broad, which is well adapted for tests of street lighting fittings In particular, the reflection from the road surface when the light is incident very obliquely and the angle of view is nearly horizontal has to be studied Every material used as a road surface, no matter how rough it may seem, shows a large amount of specular reflection under these conditions When the road is slightly worn the degree of polish is very marked Another problem that has been successfully solved is the most economical size of 'light well' to use for large blocks of buildings It is now possible from the curves and formulæ that have been published, to compute with sufficient accuracy the amount of light which will reach any point of a room facing a light well of given dimensions A problem of practical importance is to design a picture gallery so as to avoid the annoying reflections on the glass with which the pictures are covered The only satisfactory solution appears to be to arrange the windows so that as little light as possible falls on the spectators, while the full amount reaches the picture wall

Chlorine Monoxide—Goodeve, in the December issue of the *Journal of the Chemical Society*, describes experiments on the vapour pressure of chlorine monoxide, Cl_2O, which indicate that the boiling-point at 760 mm pressure is 2 0° and not 3 8° as found by Goldschmidt The freezing point is abnormally low, being −116° The value −20° reported in tables (without indication of the origin) is, therefore, much too high The vapour pressure curve of chlorine monoxide lies above that of chlorine dioxide found by Partington and King, and considerably below that of chlorine The value of the Trouton coefficient indicates that the liquid is probably not associated

Heats of Dilution—Some accurate experiments on the heats of dilution of potassium chloride in sugar and urea solutions at 25°, with concentrations below 0 1 molar, are described by Lange and Robinson in the November number of the *Journal of the American Chemical Society* The object of adding the non electrolytes was to vary the dielectric constant of water and its rate of change with temperature, the values for pure water being used in the case of solutions in which these substances were absent A linear relation at low concentrations with $\sqrt{c}$ was found, but the curves for sugar and urea were different Although agreement with theory was not obtained, it was concluded that the existing data on dielectric constants made exact comparison impossible

Nitrogen Tri-iodide—The composition of nitrogen iodide appears to vary according to the method of preparation, the ordinary substance being regarded as NI_3 NH_3 or NH_2I In the December issue of the *Journal of the Chemical Society*, Cremer and Duncan describe some experiments on the action of dry ammonia on iodine bromide or, more conveniently, a polyhalide such as $KIBr_2$, which dissociates into potassium bromide and iodine bromide In these reactions NI_3 is formed The more stable dibromo iodides, such as those of tetramethylammonium and trimethylsulphonium, do not react in this way, but form additive compounds with ammonia The iodide of nitrogen was obtained by washing with water the product of the action of ammonia gas on the polyhalide, and was a black explosive powder

Complex Salts of Bivalent Silver—Although silver is normally univalent, its analogies with copper suggest that it should also function as a bivalent metal The earliest observations on bivalent silver salts were made by Barbieri in 1912 He obtained a compound of argentic persulphate with pyridine, [Ag 4 py] S_2O_8, and in 1927 obtained the corresponding nitrate In the December number of the *Journal of the Chemical Society*, G T Morgan and F H Burstall describe some further co-ordination compounds of bivalent silver in which both two and three diamine complexes (occupying two co ordination positions) are present, indicating that the co ordination numbers 4 (as in Barbieri's compounds) and 6 are possible for bivalent silver The addendum employed was aa^1 dipyridyl, and the following compounds were obtained $[Ag_2\ 5\ \text{dipy}]S_2O_8$, $[Ag_2\ 5\ \text{dipy}](S_2O_8)_2$; $[Ag\ 3\ \text{dipy}](NO_3)_2$, $[Ag\ 3\ \text{dipy}](ClO_3)_2$, $[Ag\ 3\ \text{dipy}](ClO_4)_2$, $[Ag\ 2\ \text{dipy}](HSO_4)_2$

Prize Awards of the Paris Academy of Sciences

AT the annual public meeting of the Paris Academy of Sciences the prizes and grants for 1930 were awarded as follows

Mathematics.—The Poncelet prize to Arnaud Denjoy, for the whole of his mathematical work; the Francœur prize to Eugène Fabry, for his work on the singularities of analytical functions.

Mechanics.—The Montyon prize to Paul Le Rolland, for his work on the measurement of hardness by means of the pendulum; the Henri de Parville prize to Émile Duchêne, for his work in ballistics.

Astronomy.—The Lalande prize to Nicolas Stoyko, for his theoretical and practical work on the calculation of planetary orbits; the Valz prize to Gilbert Rougier, for his work on photoelectric cells; the Janssen medal to Bernard Lyot, for his experimental work on the polarisation of light from the planets; the Pierre Guzman prize to Alexandre Véronnet, for his works on cosmogony; the La Caille prize to Mme Edmée Chandon, for her work on the tides of the Red Sea.

Geography.—The Delalande Guérineau prize to Félix Ollivier, for his book "La topographie sans topographes"; the Gay prize to André Guillaumin, for his work on the flora of the islands of the Pacific; the Tchihatchef foundation to Jean Bathellier, for his contribution to the systematic and biological study of the Termites of Indo China; the Binoux prize to Georges Poivilliers, for his work on the application of photography to topography.

Navigation.—The Prix de la Marine to Robert Bureau and Philippe Wehrlé for their meteorological work in connexion with aerial navigation; the Plumey prize to Paul Régnauld, for his work on the strength of materials used in the construction of steamships and boilers.

Physics.—The La Caze prize to Henri Abraham, for the whole of his scientific work; the Hébert prize to Richard Langlois, for his memoir on asynchronous machines with rotating fields; the Hughes prize to Alexandre Dauvillier, for his work on the X rays; the Clément Félix foundation to Jean Lecomte, for his work on the infra red.

Chemistry.—The Montyon prize (unhealthy trades) to Roger Douris, for his work on poisonous gases; the Jecker prize to Joseph Bougault, for the whole of his work in organic chemistry; the La Caze prize to Georges Denigès, for the whole of his work in analytical chemistry; the Cahours foundation to Lucien Andrieux, for his researches on the electrolysis of metallic oxides in solution in fused boric acid, borates, or fluorides; the Houzeau prize to Paul Mondain Monval, for his work in physical chemistry.

Mineralogy and Geology.—The Cuvier prize to Maurice Gignoux, for the whole of his geological work; the Joseph Labbé prize to Jean Jung, for his geological work applied to prospecting for petroleum deposits.

Physics of the Earth.—The Victor Raulin prize to Albert Baldit, for his work on the influence of the relief and nature of the soil on the meteorological elements.

Botany.—The Desmazières prize to Frédéric Bataille, for his researches in mycology; the Montagne prize to Pierre Allorge, for his work on the Muscineæ and fresh water Algæ; the de Poincy prize to Mlle Aimée Camus, for the whole of her botanical work.

Anatomy and Zoology.—The Da Gama Machado prize to Marcel Avel, for his experimental researches on the somatic sexual characters of *Lumbricus*; the Savigny foundation to Louis Parrot, for his studies in the biting Arthropods, particularly in North Africa; Jean Thore prize to Henri Bertrand, for his researches on the larval evolution and metamorphoses of the Coleoptera.

Medicine and Surgery.—Montyon prizes (2500 francs) to Marcel Aynaud, Henri Lagrange, and Lucien Viborel; honourable mentions (1500 francs) to Paul Blum and Ernest Schaaf, to Noël Fiessinger, Henri René Olivier and Maurice Herbain, and to Henri Fischer; citations to Charles Mayer and to Gustave Rappin; the Barbier prize to Léopold Lévi, for his researches on the endocrine glands; the Breant prize between Julien Dumas (2500 francs), for his work on the bacillus of dysentery, and Stefan Nicolau, Ian Alfred Galloway, and Mme Octavie Dimancesco Nicolau; the Godard prize between Jules Janet, for his memoir on the diagnosis and treatment of blennorrhagia in man and in woman, and Pierre Gley, for his work relating to the yellow body and ovulation; the Mege prize to Henri Vignes, for his book on gynæcological physiology and medicine of women; the Dusgate prize to Henry de Varigny, for his work on death, true and false; the Bellion prize to Jean Bordas, for his work on the hygienic and economical treatment of manure; the Baron Larrey prize to Joseph Maisonnet, Daniel Petit Dutaillis, and Théophile Alajouanine, for their memoir on the remote after effects of trepanning; the Alfred Dutens prize between Henri Bordier, for his memoir on diathermy and diatherapy, and Georges Bourguignon, for his work relating to chronaxy.

Physiology.—The Montyon prize to Charles Porcher, for his book on milk from the colloidal point of view; the L. La Caze prize to Maurice Doyon, for the whole of his work in physiology; the Pourat prize to Henri Delaunay, for his researches on the nitrogenous excretion of the Invertebrates; the Martin Damourette prize to Jean Régnier, for his researches on the influence of hydrogen ions on physiological phenomena and on anæsthetics; the Philipeaux prize to Jacques Millot, for his work on the physiology of the Araneidæ.

Statistics.—The Montyon prize to René Roy, for the whole of his work on the application of mathematics to statistics and economics.

History and Philosophy of Science.—The Binoux prize (in equal parts) between Pierre Brunet and Niels Nielsen.

Works of Science.—The Henri de Parville prize to Raoul Combes, for his work on the life of the plant cell; the Jeanbernat Doria prize to Henri Volkringer, for his book, "The Stages of Physics".

Medals.—Berthelot medals were awarded to Roger Douris, Joseph Bougault, Georges Denigès, and Paul Mondain Monval.

General Prizes.—The prize founded by the State to Georges Valiron, for his work on analytical functions; the Bordin prize to Louis Dangeard, for his contributions to our knowledge of the sea floor; the Lallemand prize to Michel Raoul May, for his work on the nervous system and the grafting of sense organs; the Vaillant prize to Robert Perret, for his topographical and geological map of the mountains between the valleys of Chamonix and Sixt; the Le Conte prize to Elie Cartan, for the whole of his mathematical work; the Houllevigue prize to Georges Giraud, for the whole of his work on partial differential equations; the Saintour prize to Elie Ivanow, for his researches on the artificial impregnation of mammals; the Jules Mahyer prize to Constantin Dawydoff, for the whole of his researches in zoology and especially on the embryo

geny of the Vertebrates, the Henry Wilde prize between Maurice Leriche (2000 francs), for his palæontological researches, and Ferruccio Zambonini, for his work in mineralogy, the Caméré prize to David Wolkowitsch, for his memoir on the applications of geometry to the stability of constructions, the Gustave Roux prize to Marc André, the Thorlet prize to Adolphe Richard, the Albert I of Monaco prize to Lucien Cuénot, for his biological work

Special Foundations —The Lannelongue foundation to Mmes Cusco and Ruck, the Hélene Helbronner Fould prize to the late Mme Yves Delage

Prizes of the Grandes Écoles -The Laplace prize to Henri Feltz, the L E Rivot prize between Henri Feltz Pierre Julien Couture Émile Bideau, and Camille Henri Foin

Foundations for Scientific Research —The Gegner foundation to Désiré Bois for his book on the history, utilisation, and culture of plants used for food, the Jérome Ponti foundation to Robert Forrer for his work on magnetism the Hirn foundation to Maurice Kraitchik, for his studies in the theory of numbers, the Henri Becquerel foundation to Jean Thibaud for his work on X rays of long wave length and the joining up the ultra violet and X ray spectra, the Victor Noury foundation between Augustin Boutaric (3000 francs), for his work on colloids, Henri Baulig (3000 francs) for his book on the central plateau of France and its Mediterranean border, morphological study, the late Franz de Zeltner (2000 francs), for his work in western Africa Pierre Lamare (2000 francs), for his geological researches in the Yemen, and Raymond Hovasse for his biological and zoological work, the Charles Bouchard foundation to Léon Binet for his experimental researches on apparatus for perfusion and artificial respiration the Henry Le Chatelier foundation to Marcel Ballay for his researches on the beryllium alloys, the Pierre Lafitte foundation to Raymond Jouaust, for the whole of his work on radio electricity, the Roy Vaucouloux foundation to Joseph Magrou, for his work on the production of tubercles and galls in plants

THE LOUTREUIL FOUNDATION

The Academy has considered twenty nine applications for grants from this fund, and has made the following twenty two awards amounting in all to 121,000 francs

1 *Researches on Definite Problems* —10,000 francs to Louis Dunoyer, for the extension of his researches on photoelectric cells, 5000 francs to Raymond Ricard, for his researches on the spark spectra of metals, 5000 francs to Jacques Duclaux, for his work on the measurement of the transparency of the atmosphere, 4000 francs to Maurice Fontaine, for his researches on the physiology of marine organisms 3000 francs to François Maignon, for the continuation of the study of the influence of the seasons and of the genital glands on respiratory combustion, 3000 francs to Gabriel Petit, for his researches on the grafting of endocrine glands, 3000 francs to Jean Verge, for his researches on d'Herelle's bacteriophage and its applications in veterinary medicine 4000 francs to the viticulture laboratory of the National Hygronomic Institute (Director, Pierre Viola), for various researches in plant pathology now in progress

2 *Voyages and Exploration* —5000 francs to Charles Alluard, as a contribution towards an expedition to the southern Sahara 3000 francs to Norbert Casteret, for his spelæological explorations in the Pyrenees, 4000 francs to Auguste Méquignon, for the continuation of his entomological researches in the Azores archipelago

3 *Purchase of Material* —3000 francs to Emilio Damour for the completion of the installation of the glass laboratory at the Conservatoire national des arts et métiers, 3000 to Jean Georges Lafon, to complete the installation of electro cardiography at the physiological laboratory of the National Veterinary School of Toulouse, 1000 francs to the Arcachon Scientific Society, as an aid to building

4 *Libraries* —15,000 francs to the National Museum of Natural History, for producing a catalogue of the books contained in the laboratory libraries, 12,000 francs to the Lyons National Veterinary School, and 4000 francs to the Toulouse National Veterinary School, for increasing their libraries

5 *Publications* —5000 francs for the Fauna of the French Colonies, 5000 francs to the French Federation of Societies for Natural Science 15,000 francs for the continuation of the catalogue of the scientific periodicals in the libraries of Paris, 5000 francs to Emmanuel de Margerie, for the preparation of a geological map of Africa, 4000 francs to the Science Museum of Lyons, for assisting the publication of a memoir by L Germain on the Helicides of the French fauna

Fruit Cultivation in Great Britain

AMONG the recent bulletins issued by the Ministry of Agriculture those entitled "Fruit Production—Tree Fruits, No 2", and "Fruit Production—Soft Fruits and Nuts, No 4", are particularly welcome, as in the present economic condition of the commercial fruit growing industry all available information as to the results of recent research should be studied by growers, and, where possible, applied to the elucidation of the many problems connected with this highly specialised calling In these publications the amateur and the professional grower have access to much valuable advice, written in language at once clear and concise and not overburdened by technical terms

The factors dealt with in the opening chapter on the planning and planting of an orchard merit close attention, as miscalculations on these matters are of frequent occurrence and in after years are extremely difficult to rectify

The question of shelter is dealt with briefly, but it is difficult to over emphasise its importance in the economy of a commercial plantation, as losses from high winds occur annually, and are occasionally of a very serious character Three conifers are recommended as wind breaks, but they are comparatively expensive An excellent shelter belt may be formed by planting a mixture of common larch and spruce fir, which in a young state may be purchased at a cheap rate

Information as to progress made in classification and suitability of vegetatively propagated stocks for various purposes is extremely helpful, as many amateurs fail to realise the influence of 'pedigree' stocks on the future behaviour of their trees It is suggested that vegetatively propagated stocks, such as East Malling Types X, XII, XIII, XV, and XVI, may replace seedling stocks, but the existence of numerous orchards containing very large but possibly unremunerative apple trees testifies to the vigour of the stocks employed by earlier planters, and further information is desirable as to the ability of these standardised stocks to withstand the deleterious effects of grass

The bulletin rightly stresses the importance of a rigid selection of plum stocks, and condemns the

practice of utilising suckers, carelessly taken from plum orchards for propagation purposes, owing to the risk of working stocks infected with 'silver leaf'.

The thorny subject of pruning is dealt with in a masterly manner, and the section devoted to this important operation will appeal to the many amateur fruit growers who, owing to well meant but occasionally contradictory suggestions of numerous advisers, are hopelessly at sea on this matter. The general principles are clearly indicated; it is pointed out that no hard and fast rule can be applied to all species and varieties, but that the system of pruning should be modified in accordance with their special characteristics.

It is doubtful if the extended commercial cultivation of pears in Great Britain is worthy of consideration, as imported produce of high quality is now available for the greater part of the year. Much useful information respecting up to date storage methods is contained in a chapter devoted to this subject, but further research is needed.

Renovation of old orchards and the control of pests and diseases of fruit trees are ably dealt with, and the bulletin should be in the hands of all who wish to see an improvement in the general standard of fruit culture, and are interested in the future of an important home industry.

Bulletin No. 4 deals with 'soft fruits', which now form an important section of the British fruit industry, and its contents comprise the more important results attained by research workers and also details of sound cultural methods.

The descriptive lists of *standard commercial* varieties should be of great assistance to intending planters, and information respecting varieties suitable for canning will enable growers to cater specially for this purpose. Black currants and gooseberries in recent years have failed to give remunerative returns, and the area devoted to those crops will probably decrease. Figs and melons are among the fruits included in the bulletin, but their commercial cultivation is likely to remain in the hands of a comparatively few growers. Cob nuts and filberts realise high prices and there appears to be ample scope for their extended cultivation; the nut is not fastidious as to soil, but possibly the prevailing system of land tenure is responsible for the small area devoted to this and other 'permanent' crops.

Rainfall of the United States

SUPPLEMENT Number 34 of the *Monthly Weather Review* of the United States Department of Agriculture is a summary giving the main results of fifty years of organised rainfall measurement, in the form of daily, fortnightly, monthly, and annual normals of precipitation for the regular first order stations of the U.S. Weather Bureau.

The need for a revision of the normals for the United States available before this publication appeared arises from the fact that the last revision was made so long ago as 1907, since when many new stations have been started. The new normals all refer to the period January 1878 to December 1927 inclusive. Where a complete record has not been available, the usual procedure has been adopted, namely, an adjacent station has been selected for which the full fifty years' record is available, and its measurements have been compared with those at the station with the incomplete record throughout the period of overlap of the two records. In this way the relative degree of wetness has been obtained, and thence a correction which, when applied to the normal computed from the period of overlap, gives a close approximation to the required normal.

A publication of this kind, consisting of little more than a vast array of figures in tabular form, is clearly not to be regarded as reading matter in the ordinary sense even for the expert meteorologist. It would, however, have been more nearly so had there been a key map showing the positions of all the places for which normals are given, preferably with shaded or coloured altitude zones, and any other features that might assist in explaining the great diversity in the amount and seasonal distribution of the precipitation, which a careful inspection of the tables reveals. For the work has under review the rainfall of a country in which virtually rainless areas exist side by side with areas of great altitude and wetness, where lofty mountain peaks force the moist westerlies from the Pacific to rise and undergo such dynamical cooling that a large proportion of their moisture is condensed to rain or snow. A rapid survey of the normal annual falls did not reveal any total that is not surpassed in the Lake District of England, but showed many smaller than can be found anywhere in the dry eastern lowlands of England and Scotland. Yuma, Arizona, has the interesting annual normal of 3.47 inches, based on a full fifty years' record.

In addition to its value in general climatology, this work is obviously of the first importance to American water engineers and to many of the industries of the States, particularly farming. E. V. N.

Parliamentary Representation of the Universities of Great Britain

IN view of the clause relating to the abolition of university constituencies which appears in the Representation of the People Bill, the text of which has recently been issued, a joint memorandum has been submitted to the electors of the Universities of Oxford and Cambridge by their present parliamentary representatives. The memorandum gives a brief history of university representation in Great Britain. In 1603 James I., by a charter issued on the advice of his Attorney General, Sir Edward Coke, granted to the Universities of Oxford and Cambridge the right, which they have ever since enjoyed, of each returning two burgesses to Parliament. A similar right of representation in the Irish Parliament was accorded to Trinity College, Dublin, ten years later. By the time of the outbreak of the War there were nine university members in the House of Commons, returned by the following constituencies:

	Voters
Oxford (2)	6,895
Cambridge (2)	7,145
Dublin (2)	5,020
London (1)	6,070
Edinburgh and St. Andrews (1)	11,319
Glasgow and Aberdeen (1)	11,714
	48,163

A large measure of parliamentary reform and a great extension of the franchise were undertaken by the Coalition Government in 1918. Three new university constituencies, the Combined English Universities,

the University of Wales, and Queen's University, Belfast, were created, and the Scottish universities were awarded an additional member At the same time, reforms were effected in the qualification for the university vote which immensely increased the number of voters in the existing university constituencies, particularly in Oxford and Cambridge It was also enacted that whenever a university constituency returned two or more members, the elections should be conducted according to that variety of proportional representation known as the single transferable vote

As a result of these reforms, the university constituencies, at the date of the general election in 1929, were as follows

	Voters
Oxford (2)	15,770
Cambridge (2)	23,978
London (1)	15,558
Scottish Universities (3)	43,192
Combined English Universities (2)	13,775
University of Wales (1)	3,623
Queen's University, Belfast (1)	3,324
	119,220

In place, therefore, of five constituencies (if Trinity College, Dublin, be omitted) with 43,143 voters returning seven members, there are seven constituencies with 119,220 voters returning twelve members Nor is the process of expansion nearly completed, especially at Oxford and Cambridge Although these two constituencies have more than doubled in numbers since the franchise was altered in 1918, they will undoubtedly double themselves again in the next twenty years, as the existing regulations, which provide for the automatic registration of all British subjects who take degrees, gradually equate the number of voters with the number of living graduates of the university It may therefore, be predicted that if the representation of the universities in Parliament is left undisturbed for a generation, the twelve members will be representing a body of between 200,000 and 250,000 graduates

When account is taken of the very large numbers of men and women students, from all grades of society, including those who began their education in our primary schools, who now make their way to Oxford and Cambridge, and of the still larger numbers who proceed to the Scottish and the modern English universities, of the pronounced success which has attended the efforts of the universities to provide a training suitable to students entering on professional, commercial, or industrial careers, and of the fact that the general widening of the educational ladder has not yet had time to bear its full fruit, it is claimed that graduates of the universities of Great Britain, as a whole, represent to-day, even more fully than they did half a century ago, that section of the community which exercises the greatest influence on the formation of public opinion

Of 1263 men students matriculated at Oxford during the academical year 1928–29, less than half came from the English public schools Of the remainder, 179 were students from overseas, and 445 were from secondary schools which do not rank as public schools Of these 445, no fewer than 223 had started their education in public elementary schools, which means that at any time there are about 750 elementary schoolboys in residence at Oxford, and the proportion to the whole would be at least as large amongst the women students The evidence also shows that more than 45 per cent of Oxford undergraduates are in receipt of financial assistance without which their parents would be unable to give them a university education The figures for Cambridge are similar, and at some of the modern English universities more than two-thirds of the students began their education in the elementary schools

Further justification for the existence of a small number of university representatives in the House of Commons is found in the special knowledge they may be expected to have of the needs of higher education and educational policy generally The independence from government control enjoyed by the universities of the British Empire can only be maintained by very cordial co operation between the governing bodies of the universities and the Government of the day, and in the delicate negotiations which such co operation constantly involves, the university members play a part which is essential, although it naturally does not bulk in the public eye

The university constituencies, by reason of their peculiar constitution, provide for the enfranchisement of a large number of men and women who would otherwise be without a vote Since the university voter is placed on the register for life, and can vote through the post, he carries his qualification with him wherever he goes, he can exercise it although, owing to a change of residence, he may be without an ordinary vote, or unable to travel to a constituency to exercise it if he goes abroad, he can appoint a proxy, and, with the recent extension of air mails, he can now exercise the franchise himself from a great many distant parts of the world A careful analysis of 900 consecutive voters on the Oxford Register showed that no fewer than 75 had addresses overseas, many of them serving their country in distant parts of the Empire, which means that at Oxford alone the abolition of the University seat would disfranchise nearly 1500 overseas voters In the Scottish universities the proportion of overseas voters is probably higher

University and Educational Intelligence

CAMBRIDGE —Applications are invited for a research studentship at Emmanuel College, the maximum annual value of which will be £150 and the period of holding two years or a possible third Preference will be given to candidates who have completed one but not more than two years of research work Applications must be received by the Master of Emmanuel College by, at latest, June 30

THE Air Ministry announces that five hundred aircraft apprentices, between the ages of fifteen and seventeen years, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton Bucks, and at Cranwell, near Sleaford, Lincs They will be enlisted as the result of an Open Competition and of a Limited Competition, to be held in the near future by the Civil Service Commissioners and the Air Ministry respectively Boys in possession of an approved first school certificate may be admitted without other educational examinations The scheme offers a good opportunity to well educated boys of obtaining a three years' apprentice course of a high standard The principal trades open to them are metal rigger, a new trade brought into existence by the introduction of the metal aeroplane, which involves training in both fitting and sheet metal work, fitter (aero engine), fitter (armourer), wireless operator-mechanic, and electrician Full information regarding the examinations can be obtained upon application to the Secretary, Air Ministry (Aircraft Apprentices' Dept), Gwydyr House, Whitehall, London, S W 1

Birthdays and Research Centres.

Feb 3, 1872 —Prof F J COLE, F R S , professor of zoology, University of Reading

My chief studies at present are concerned with the history of zoological discovery

Feb 4, 1875 —Dr LUDWIG PRANDTL, For Mem R S , director of the Kaiser Wilhelm Institute for Research on Fluid Flow at Göttingen

In the Wilbur Wright Lecture before the Royal Aeronautical Society in May 1927, I pointed out that after the very satisfactory explanation of the lift on aerofoils and of all similar related problems, it is necessary to investigate the problem of resistance more closely, and that turbulence is an important factor in connexion with this latter question Turbulence is that internal unrest in fluid motion which produces a continual mingling of fluid particles from the neighbourhood of the wall with those somewhat farther away, and as a result, frictional forces are increased, but the stream line pattern approximates more closely to the form calculated for ideal fluids

During the last few years, the investigations in my Göttingen Laboratory have gone into the properties of turbulent flow in great detail, and have, in fact, produced several important explanations But much remains to be done, and much more work is necessary before the experimental results can be explained with the desired clarity

Feb 5, 1866 —Sir ARTHUR KEITH, F R S , Hunterian professor and Conservator of the Museum of the Royal College of Surgeons

I am continuing my lifelong search for evidence bearing on the origin of man and of anthropoid apes Especially am I concerned with factors which regulate or influence development and growth

Feb 6 1852 —Dr CONWY LLOYD MORGAN, F R S , emeritus professor of psychology in the University of Bristol

One who enters on his eightieth year is not likely to be able to furnish an interim report of any new investigation now in progress More probably he asks himself What should I do were I near the start of my life work instead of fast approaching its close ?

Realising that comparative psychology is still in its infancy, I should concentrate attention for another lifetime on the earlier stages in the evolutionary genesis of mind in its natural process of concrescence I should still urge that, since maturity is, in each individual, a novelty emergent on infancy, it does not accord with sound method in science to account for infantile (and even embryonic) occurrences in terms of mature processes if, on the available evidence, such processes are not as yet emergent in that instance of concrescent advance which is under scientific consideration

Feb 6, 1871 —Lieut Col J STEPHENSON, F R S , Indian Medical Service (retd), formerly lecturer in zoology in the University of Edinburgh

The main objects of my anatomical and systematic work on the Oligochæta are (1) the tracing out of the course of evolution within the group—certain families, for example, the Megascolecidæ, allow lines of descent to be traced within them with more and more certainty as our knowledge of the anatomy and distribution of their members increases , (2) to contribute to the science of palæogeography by means of an increasingly accurate knowledge of the earthworm faunas of the several regions of the globe Since earth worms for the most part spread only by their own slow progression in the ground, to a life in which they are absolutely confined, a knowledge of the distribution of the various genera affords valuable material for determining the configuration of the land in former epochs

Societies and Academies

LONDON

Royal Society, Jan 22 —P M S Blackett and F C. Champion The scattering of slow α particles in helium Mott has calculated the scattering of α particles by helium atoms on the assumption that the particles interact according to the inverse square law, that they have no nuclear spin and that they obey the Einstein Bose statistics It is found that the scattering should vary periodically with changing angle and velocity in fact an interference pattern should be obtained the scale of which depends on the velocity This theory has been tested by photographing the collisions between slow α particles and helium atoms in a Wilson chamber The results are in complete agreement with Mott s theory —W A Bone, R P Fraser, and F Lake Explosions of mixtures of acetylene and electrolytic gas The disturbing influence of successive additions of acetylene upon the uniformity of the initial flame movement in an explosion of electrolytic gas attains a maximum when 20 per cent of acetylene is present in the medium, thereafter declining and eventually disappearing when 30 per cent of acetylene is present There is a primary selective partial combustion of acetylene, $C_2H_2 + O_2 = 2CO + H_2$ in the flame front followed, behind the flame front by either (i) when sufficient oxygen is present a highly luminous combustion of the nascent carbon monoxide or (ii) otherwise by a thermal decomposition of any unburnt acetylene The explosion of a $C_2H_2 + O_2 + 2H_2$ mixture is differently affected by an equal dilution with argon or nitrogen —W A Bone and R P Fraser Flame speeds in the inflammation and detonation of CO O_2 mixtures In the initial phase of inflammation , and in the final stage of detonation , the maximum flame speed for moist mixtures at atmospheric pressure is obtained with a *circa* $3CO + O_2$ instead of a theoretical $2CO + O_2$ mixture Dilution of the medium with either argon helium or nitrogen does not materially alter the proportions of carbonic oxide and oxygen in the maximum speed mixture Hence the point of maximum flame speed is principally determined by the concentration of carbon monoxide and the combustion of moist carbonic oxide is conditioned by a prior excitation of its molecules, which are then rendered combustible —C V Jackson Interferometric measurements in the arc spectrum of iron Ten lines in the spectrum of the iron arc in air, between $\lambda 4000$ and $\lambda 4400$ have been measured by interferometric comparison with the red line of cadmium or with the secondary standards of neon Sixty eight lines in the spectrum of the iron arc in air between $\lambda 2300$ and $\lambda 3100$ have also been measured interferometrically The results are in good accord with the wave lengths recommended by the International Astronomical Union in 1928

EDINBURGH

Royal Society, Jan 12 —J W Gregory The Dalradian rocks of Scotland and the structure of the Southern Highlands The Dalradian rocks can be traced across the Southern Highlands of Scotland from Argyll to the Moray Firth and the coast south of Aberdeen The author in 1910 rejected the

generally accepted conclusion that the oldest Dalradian rocks outcrop along the southern border of the Highlands, and that there is an ascending series to the Moine gneiss to the north He regards the slates and grits to the south as a younger but still pre Palæozoic series (the Lennoxian), and as composed of Dalradian debris, the Dalradian band as consisting of five series, with the youngest to the north, and the Dalradian beds as having been deposited on the southern flank of a land composed of the Moine The evidence for these conclusions is submitted in detail The author regards the beds as in their original order, except where locally inverted as in Ben Lui and near Callander He correlates the north eastern Dalradian and Lennoxian rocks south of the Moray Firth with those of Perthshire and south west Scotland, from which they are separated by the granites of the Cairngorms and western Aberdeenshire —**J Weir** The British and Belgian Carboniferous Bellerophontidæ Eighty two forms are discussed under nine genera The Bellerophontid faunas of various horizons and facies are tabulated and discussed, and attention is directed to assemblages of stratigraphical value in the Scottish Carboniferous succession and equivalent rocks in the north of England, with special reference to stages in the evolution of *Euphemus urei*, *Bucaniopsis decussatus*, and *Tropidocyclus oldhami* —**Elsie J Cadman** Life history of *Didymium nigripes* *Didymium nigripes* is a species belonging to the slime fungi or Mycetozoa found growing on germinating beet 'seeds', and it also grows frequently on dead leaves of many kinds The spores germinate readily, each spore giving rise to two swarm cells, because germination is preceded by a division within the spore coat At the division four chromosomes are present, and there are distinct centrosomes After several divisions the swarm cells withdraw their flagella and become transformed into myxamœbæ The myxamœba possesses no flagellum and no bleparoplast and cannot become a swarm cell again They fuse in pairs to form zygotes A plasmodium which may be slightly bigger than those in its neighbourhood, either because it possesses a great number of nuclei or has engulfed a larger number of myxamœbæ, can exert some form of attraction on the smaller plasmodia around it, and they coalesce with it in large numbers A large plasmodium, therefore, rapidly increases in size, and continues to do so by coalescing with the smaller plasmodia in its neighbourhood Chromosome numbers were fully investigated —**R Crookall** The genus *Lyginorachis* Kidston This genus was instituted by the late R Kidston, of Stirling, to include petrified leaf stalks with a structure similar to that of the well known Coal Measure plant *Lyginopteris oldhamia* Though Kidston recognised and named two species of *Lyginorachis*, he described neither In his admirable "Studies in Fossil Botany", Dr D H Scott described, but did not figure, *L papilio* from the Cementstone Group (Calciferous Sandstone Series) of Norham Bridge, Tweedside The second species was appropriately named by Kidston *Lyginorachis taitiana* It was referred to, but not described, by Dr Scott Fortunately, Kidston had prepared excellent photomicrographs of both forms, and these are used to illustrate the paper —**J Geronimus** Some problems involving the persymmetric determinants

ROME

Royal National Academy of the Lincei Communications received during the vacation —**F Enriques** Algebraic surfaces —**G Barba** Generalised parallelism —**F Odone** Rotation and divergence of a vector, gradients of a homograph in general curvilinear coordinates —**Maria Pastori** Further on the partial derivation of tensors —**P Cattaneo** A class of cyclic varieties —**M G Bouligand** General expression for the solidarity between the problem of the minimum of an integral and the corresponding Hamilton-Jacobi equation —**G Andreoli** Pseudo-limits of functions, pseudo continuity, etc —**M Manarini**: Lines of curvature and geodetics of a surface —**S Finikoff** The "suites" of M Fubini —**G Bozza** Action of certain apparatus for blowing gases —**G A Barbieri** Complex thiocyanates of quadrivalent molybdenum Various difficulties are encountered in the preparation of these compounds, but a number of them have now been obtained by carefully oxidising the corresponding tervalent molybdenum derivatives by means of potassium ferricyanide —**Giambattista Dal Piaz** New genera and new species of artiodactyls in the Venetian oligocene Investigation of the numerous fossil artiodactyls of the Basle Museum indicates that the genus *Anthracochœrus* occupies a completely isolated systematic position and shows a tendency to diverge from the complex type of *Anthracotheridæ* and to approach in some respects that of certain primitive *Suidæ* It is concluded that the Monteviale artiodactyl is not related to any of the numerous phylogenetic lines of the *Anthracotheridæ*, but represents a type of which neither the eocene ancestors nor any oligocene successors are known —**G Brunelli** Monotonous rotifer planktons in an elevated Apennine lake The plankton of Lake Scanno consists mainly of *Cyclops strenuus* Fischer and of large masses of the rotifer *Asplanchna priodonta* Gosse —**Teodoro Perri** Behaviour of the optical vesicle of *Triton* grafted into embryos of *Rana esculenta* (Destruction and power of recovery) —**Giulio Cotronei** and **Aldo Spirito** Zoological constitution and grafts New experiments between Anura and Urodela (4) —**G Mezzadroli** and **E Vareton** Action exerted by radium on the germination of seeds Experiments in which barley, wheat, peas, and beans were subjected to the influence of the γ rays of radium show that the effect of a short exposure on the germination of the seeds is beneficial and that of a long one injurious When 3 9 mgm of radium was used, benefit became appreciably apparent after 5 minutes and reached a maximum after 30 minutes With one half of this amount of radium, the exposure must be quintupled The best result obtained consisted of increases of 30 per cent in the number of seeds germinated, 80 per cent in the total height, and 80 per cent in the weight of the plants The stimulating effect is still active two months after the irradiation

SYDNEY

Royal Society of New South Wales, Oct 1 —**H G Roggatt** Thrust faults and compression joints in the Muree beds, near Grasstree, New South Wales The beds in which the faults and joints occur, consist of sandstone and conglomerate—competent rocks—overlain and underlain by shale and mudstone—incompetent rocks—constituting an ideal series for the development of compression phenomena Stress in a sandstone member is expressed by sharply defined faults which pass upward into conglomerate as monoclinal or slightly overturned folds These thrust faults are inclined to the horizontal at an angle of about 30° Joints are developed in two sets, one parallel to the faults and one inclined thereto at 120° The fractures appear to obey Mohr's theory of rupture and furnish striking practical confirmation of Hartmann's law Since the direction of thrust is known, the orientation of the strain ellipsoid is known, showing that the axis of maximum compression lies in the *acute* angle between the shear planes Experimental determination of the angle of friction of the sandstone confirms

the view that the principal factor tending to reduce the fracture angle to less than 45° is the internal friction of the rock itself —**A J Matheson** The geology of the Wellington district, N S W, with special reference to the origin of the Upper Devonian Series The oldest rocks are of Silurian age, comprising shales and limestones in which are interbedded a great volcanic series The limestone occurs on two horizons and both are coralline, the upper limestone is the more highly fossiliferous and is the youngest of the Silurian rocks It passes by a gradation through an arenaceous type into a calcareous sandstone and, finally, into sandstone itself, the sandstone series, in its upper part, contains *Lepidodendron Australe* and *Spirifer disjunctus*, and is, therefore, of Upper Devonian age Sandstones are characteristically red in colour, and it is suggested that they were deposited under arid conditions They are intruded by the Wuuluman granite —**G F K Naylor** The history of the development of the present drainage system in the Marulan district Theories involving river capture were advanced by Andrews in 1904 and by Woolnough and Taylor in 1906 Andrews suggested that the old Shoalhaven was beheaded by a tributary of the Hawkesbury, while the other writers postulated an old Wollondilly beheaded by a newly formed coastal stream The theory now being put forward suggests that the present Shoalhaven Kangaroo system originally flowed in a westerly direction away from the coast, in a manner analogous to the present Upper Nepean system Capture and reversal by a coastal stream which developed as a result of the post Tertiary uplift is regarded as having brought about the present river distribution —**A R Penfold** and **F R Morrison** Notes on the essential oils from some cultivated Eucalypts (2) The species consisted of *E Australiana*, *E Macarthuri*, *E citriodora*, *E Smithii*, *E dives*, and *E dives* variety 'A' and variety 'B' Leaves from the trees of an avenue of *E bicostata*, near Sydney, show considerable variation in size and shape although grown from the seed of one tree collected at Jenolan, New South Wales The yield of oil varied from 1 23 to 2 4 per cent and the cineol content from 38 to 65 per cent The species is really a form of *E globulus* confined to the mainland of Australia and should have been named *Eucalyptus globulus* variety *bicostata* The chemical constituents of the oil are similar to those of *E globulus*, namely, isovaleric aldehyde, *d* α pinene, cineol, eudesmol, etc

Official Publications Received.

BRITISH.

British Chemicals and their Manufacturers the Official Directory of the Association of British Chemical Manufacturers (Incorporated) Pp 405 (London) Free

The British Chemical Plant Manufacturers Association Official Directory of Members 1931, with a Classified List of their Manufactures and Services Pp. 151 (London) Free

County Borough of Southport Meteorological Department The Fernley Observatory Southport Report, and Results of Observations for the Year 1929 By Joseph Baxendell Pp 28 (Southport)

The National Capital. The Presidential Address of Sir Josiah Charles Stamp delivered to the Royal Statistical Society, November 18, 1930 Pp. 24 (London Royal Statistical Society) 1s 6d

The Observer s Handbook for 1931 Published by the Royal Astronomical Society of Canada Twenty third Year of Publication Pp 77 (Toronto)

Food Fakes Ancient and Modern By E Gabriel Jones Pp 24 (London Institute of Chemistry)

Catalogue of the Twenty first Annual Exhibition of Electrical, Optical and other Physical Apparatus, January 6, 7 and 8, 1931 Pp 160+xl (London The Physical Society and the Optical Society) 6d.

The Proceedings of the Royal Society Series A, Vol 130, No A813, January 1 Pp 289 481 (London Harrison and Sons, Ltd) 10s

Department of Scientific and Industrial Research Water Pollution Research Summary of Current Literature Vol 4, Part 1 January 1931 Abstracts Nos 1 186 Pp 185 (London H.M Stationery Office.) 1s 3d net.

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1929 Pp. 44 (Entebbe Government Printer) 8s.

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 46 Black Disease (Infectious Necrotic Hepatitis) of Sheep in Australia a Toxæmia induced by a Specific Bacterium (B œdematiens) in Hepatic Lesions resulting from the Migration of young Liver Flukes (F hepatica). By Dr A W Turner. Pp 141 (Melbourne H J Green)

The Indian Forest Records Entomology Series, Vol 14 Parts 11 to 14 On some Indian Coleoptera Part 11 A new Genus and a new Species of Melasidae and a New Species of Elateridae, by E Fleutiaux, Part 12 A new Genus and Two new Species of Longhorn Beetles from India (Coleoptera Cerambycidae Subfamily Lamiinae) by W S. Fisher Part 13 Immature Stages of Indian Coleoptera (7) by J C M Gardner Part 14 Three new Species of Lyridae, by R Kleine. Pp. iii+17+3 plates (Calcutta Government of India Central Publication Branch) 1 rupee 1s. 9d

FOREIGN

United States Department of Agriculture Circular No 145 *Typhia popilliavora* Rohwer a Parasite of the Japanese Beetle By J L. King and J K Holloway Pp 12 10 cents Technical Bulletin No 215 A Biological Study of *Trichogramma minutum* Riley as an Egg Parasite of the Oriental Fruit Moth By Alvah Peterson Pp 22 5 cents (Washington D C Government Printing Office)

Report of the Director of the Institute for Biological Research V, 1929 1930 Pp 11 (Baltimore Md Johns Hopkins University)

Memoirs of the College of Science Kyoto Imperial University Series A Vol 13 No 6, November Pp 300 397 (Tokyo and Kyoto Maruzen Co Ltd) 1 00 yen

The Science Reports of the Tohoku Imperial University, Sendai, Japan First Series (Mathematics Physics Chemistry) Vol 19, No 4 Pp 365 472 (Tokyo and Sendai Maruzen Co, Ltd)

U S Department of Commerce Coast and Geodetic Survey Serial No 481 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Sitka Alaska, in 1923 and 1924 By W N McFarland Pp ii+102+10 plates (Washington, D C Government Printing Office) 50 cents

Mitteilungen des Geologischen Instituts der Landbouwhoogeschool in Wageningen (Holland) No 16 i Vergleichende mikroskopische physikalische und chemische Untersuchungen von einem Kalkstein und einem Loss Bodenprofil aus den Niederlanden ii Vergleichendes Studium von einem Kalkstein Bodenprofil aus Holland und einem Kalkstein Bodenprofil aus Java Unter Mitwirkung von Prof A Te Wechel Dr I M [illegible]ser und C van Aggelen Bearbeitet von Prof J van Baren Met een Beknopte Samenvatting in de Nederlandsche Taal Pp 105+20 Tafeln (Wageningen H Veenman en Zonen)

CATALOGUE

Radio Malt Pp 14 (London The British Drug Houses, Ltd)

Diary of Societies

FRIDAY, JANUARY 30

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Dr D Hunter Changes in the Bones in Hyperparathyroidism and Hyperthyroidism

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre) (at Corporation Electricity Showrooms Swansea), at 6 —J Urmston The Electrical High Pressure Testing of Cables and the Localisation of Faults

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle upon Tyne), at 6 —C F Christensen The Whaling Factory Ship *Vikingen*, with Some Notes on Whaling

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —W Fish Modern Methods of Production of Small Machined Work

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof G M Trevelyan The First Defence of Gibraltar by the English, Oct 1704–April 1705

ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—Col the Master of Sempill Gliding and Soaring

SOCIETY OF DYERS AND COLOURISTS (Scottish Section) —D K Colledge Dyeing for the Scottish Tweed Trade

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section)

SATURDAY, JANUARY 31

BRITISH MYCOLOGICAL SOCIETY (in Botanical Department University College) at 11 A M —*Dr A S Horne* (*a*) *Nuclear Division in Spongospora* (*b*) Preliminary Study of the Fungus Flora of the Air —N M Nitimargi Factors Influencing Spore Formation —L N Seth Factors Influencing Fungal Growth —W C Moore and Dr A Smith Notes on Some Interesting Fungi Recently Recorded —A A Pearson A Fungus Foray in Spain

MATHEMATICAL ASSOCIATION (at *Bedford College for Women*), at 3 —Annual Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Dr E Cammaerts Flemish Art (2) Breughel

MONDAY, FEBRUARY 2

ROYAL SOCIETY, EDINBURGH, at 4 30 —Sir E A Sharpey Schafer Observations on the Relative Rate of Growth of the Nails of the Right and Left Hands respectively on Seasonal Variations in the Rate, and on the Influence of Nerve Section upon it —Dr F J W Whipple A Note on the Secular Changes of Rock Temperature on the Calton Hill —*To be read by title* —Prof E L Ince Zeros and Turning Points of the Elliptic Cylinders

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —H. H Woollard The Potency of the Pharyngeal Entoderm

ROYAL INSTITUTION OF GREAT BRITAIN at 5 —General Meeting

SOCIETY OF ENGINEERS (at Geological Society), at 6 —H W Towse Presidential Address

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cardiff), at 7 —D B Hoseason The Cooling of Electrical Machines.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Prof W Rothenstein The Decoration of Buildings
ROYAL SOCIETY OF ARTS, at 8 —Prof L. C Martin Some Modern Developments in Microscopy (Cantor Lectures) (2).
SOCIETY OF CHEMICAL INDUSTRY (London Section) (jointly with Faraday Society and Chemical Engineering Group) (at Chemical Society), at 8 —Dr E B Maxted The Specific Activity of Catalysts —Prof E K Rideal Specific Catalytic Surfaces.
BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8 30 —Miss Ella Freeman Sharpe Sublimation A Correlation between the Experiences of an Educator and Psychoanalyst.

TUESDAY, FEBRUARY 3

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr J W T Walsh The Art of Illumination (3).
ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr Nellie B Eales The Development of the Mandible in the Elephant —A. D Middleton A Contribution to the Biology of the Common Shrew (*Sorex araneus* Linn).—F C Baker The Classification of the Large Planorboid Snails of Europe and America —S Maulik On the Larva of the Poisonous Chrysomelid Beetle of N gamiland, Africa —Dr C Crossland The Reduced Building Power and the Variations in the Astrean Corals of Tahiti with a Note on *Herpetolitha limax* and *Fungia* sp — Dr Marie V Lebour (*a*) Further Notes on Larval Brachyura (*b*) The Larvæ of the Plymouth Caridea I The Larvæ of the Crangonidæ II The Larvæ of the Hippolytidæ
INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce Birmingham), at 7 —C E Moore, I A Bailey, and others Discussion on Refractories
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —F Judge Some Early Experiments in Colour Photography
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 45 —Dr W H Hatfield Rustless Steels as applied to Automobiles and Aircraft.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —Prof M Herskovits The New World Negro as an Anthropological Problem

WEDNESDAY, FEBRUARY 4

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —T P Dunhill Malignant Disease of the Thyroid Gland—the Relation of the Incidence and Spread to its Embryology and Prognosis
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6 —P K Turner Some Measurements of a Loud Speaker *in vacuo*
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society) at 8 —Dr L. H Lampitt and J H Bushill Some Factors affecting the Solubility of Milk Powder —S Marks and Dr R S Morrell (*a*) The Determination of the Hydroxyl Content of Organic Compounds Estimation of Castor Oil (*b*) The Determination of the Carbonyl and Aldehyde Content of Organic Compounds Estimation of Phenylhydrazine —Dr A van Raalte and J Straub Food Control in Holland —H R Ambler The Determination of Small Quantities of Methane —R. Bhattacharya and Dr T P Hilditch The Fatty Acids and Component Glycerides of Indian Ghee
ROYAL SOCIETY OF ARTS at 8 —C Le Maistre The Effect of Standardisation on Engineering Progress.
ROYAL SOCIETY OF MEDICINE (Surgery and Pathology Sections), at 8.30 —V Z Cope and P H Mitchiner (Surgery), Dr A Fleming and Dr T H C Benians (Pathology) Special Discussion on Indications for and the Value of the Intravenous Use of Germicides
ROYAL MICROSCOPICAL SOCIETY (Biological Section) (in B M A House Tavistock Square).

THURSDAY, FEBRUARY 5

ROYAL SOCIETY at 4 30 —C F Jenkin The Pressure Exerted by Granular Material —F L. Arnot The Diffraction of Electrons in Mercury Vapour S Rama Swamy On the Transmission of Light by Thin Films of Metal —*Papers to be read in title only* —S Goldstein The Forces on a Solid Body Moving through Viscous Fluid (Notes by J M Burgers).—D C Colbourne The Diurnal Tide in an Ocean Bounded by Two Meridians
LINNEAN SOCIETY OF LONDON, at 5 —Dr M Bernhauer and Dr H Scott Abyssinian Staphylinidæ —S Savage On a Recently discovered Letter from Linnæus dated 1750 —I H. Burkill Photographs of *Dioscorea esculenta* taken in Siam by Dr A F G Kerr — Dr T A Sprague and C V B Marquand The New Flora of Gore Cliff Landslide
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 — Prof G N Watson Ramanujan s Note Books (Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN at 5 15.—Prof H Dingle The Nature and Scope of Physical Science (3).
BRITISH ASSOCIATION OF REFRIGERATION (at Institution of Mechanical Engineers), at 5 30 —Dr Ezer Griffiths Some Instruments for Refrigeration Work
INSTITUTION OF ELECTRICAL ENGINEERS at 6.—P J Ryle Two Transmission Line Problems Suspension Insulators for Industrial Areas in Great Britain , Conductor Vibration
INSTITUTE OF CHEMISTRY (Manchester Section) (at " Manchester, Ltd , Manchester) at 7 —Prof F L Pyman Paper
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Institute of Fuel) (at Bristol University), at 7 30 —M H Lewis Recent Development in the Economic Production of Steam from Factory Boiler Plants.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Section of Institute of Chemistry and Microscopical Society of Wales) (at Cardiff Technical College), at 7 30.—C A. Seyler The Microstructure of Coal
CHEMICAL SOCIETY, at 8 —J W Baker Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group Part I The Carbonyl Group in Benzaldehyde and Acetophenone.—J W Baker and W G Moffitt Salt-forming Characteristics of Doubly and Singly Linked Elements of the Oxygen Group. Part II The Nitration of Benzaldehyde and Acetophenone in Sulphuric Acid Solution. —Prof T M Lowry and G Jessop The Properties of the Chlorides of Sulphur Part V Metastable States.—J W Cook (*a*) Polycyclic Aromatic Hydrocarbons Part II The Non-existence of 1 2 7 8-dibenzanthracene (*b*) Part III Derivatives of 1 2 5 6-dibenzanthracene , (*c*) Part IV Condensed Derivatives of 1 2 benzanthracene.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology and Disease in Children Sections), at 8.—Dr A Castellani and Dr G W Bray (Tropical Diseases), Dr A. R. Neligan and Dr H S Stannus (Disease in Children) Special Discussion on The Adaptation of European Women and Children to Tropical Climates.

FRIDAY, FEBRUARY 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 30 A.M —Sir St. Clair Thomson, F C Ormerod, and others Discussion on Tuberculosis of the Ear
ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4 30.—The Escape of Radiation from the Atmosphere Chairman, Sir Gilbert Walker Opener, Dr G C Simpson, followed by Sir Napier Shaw, Dr F J W Whipple, and Prof E A Milne
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4 30 —Discussion on The Treatment of Frontal Sinusitis.
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5 —H E Beckett The Radiation Reflecting Powers of Rough Surfaces —E B Moss A Ballistic Recorder for Small Electric Currents.—F J Scrase The Instrumental Phase Difference of Seismograph Records.—Demonstrations by G L. Addenbrooke
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of the Rubber Industry) (at Engineers Club, Manchester), at 7 —A Fraser Plant Used in the Manufacture of Synthetic Resins —Dr E E Walker and E A Bevan The Effect of Certain Factors upon the Electrical Properties of Moulding Powder and Synthetic Resins.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —R. Davis G W Bowdler and W G Standring The Measurement of High Voltages, with special reference to the Measurement of Peak Voltages —Dr L E Ryall The Construction and Operation of a Simple Neon Tube High Tension Crest Voltmeter —S Whitehead and A P Castellain Sphere-Gap Calibration
INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Literary and Philosophical Society, Newcastle-upon Tyne), at 7 — Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture).
OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 —Members Evening
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7 —Informal Meeting
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30.—J W White Aerial Wire Ropeways
GEOLOGISTS ASSOCIATION (in Botany Theatre University College) (Annual General Meeting), at 7 30 —Prof W W Watts Bournes (Presidential Address)
ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —J M Keynes The Internal Mechanics of the Trade Slump.

SATURDAY, FEBRUARY 7

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Dr E Cammaerts Flemish Art (3) Rubens

PUBLIC LECTURES.

SATURDAY, JANUARY 31

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Miss M A Murray Most Ancient Egypt

MONDAY, FEBRUARY 2

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —J C Dawes Public Cleansing The Disposal of House and Trade Refuse

TUESDAY, FEBRUARY 3

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5 —Dr P Manson Bahr The Dawn of Tropical Medicine, being an Account of the Life and Work of Sir Patrick Manson
UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15.—Dr W Cramer Filterable Tumours (Succeeding Lecture on Feb 10)

WEDNESDAY, FEBRUARY 4

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr W G Savage Food Poisoning
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5 30 —Prof C G Darwin The Foundations of Atomic Mechanics. (Succeeding Lectures on Feb 5 and 6)
KING S COLLEGE, LONDON, at 5 30 —Prof A P Newton The Great Age of Discovery (3) Christopher Columbus and his Rivals
BELFAST MUSEUM AND ART GALLERY, at 8.—E Godfrey Brown Wind Instruments.

THURSDAY, FEBRUARY 5.

KING S COLLEGE, LONDON, at 8.—C J Gadd Babylonian Religion
BEDFORD COLLEGE FOR WOMEN, at 5 15.—Lady Chatterjee Indian Labour Problems.

SATURDAY, FEBRUARY 7

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W C 1), at 3.—Prof E . Salisbury Some Rarer British Plants and their Distribution
HORNIMAN MUSEUM (Forest Hill), at 3 30.—Dr F A Bather The Cuttle Fish and its Ancestors.

SATURDAY, FEBRUARY 7, 1931

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International Health

THE report on the Health Organisation of the League of Nations adopted by the last Assembly noted the success which international co-operation can achieve in technical matters Co-operation in health matters is indeed relatively easy there are few, if any, vested interests comparable with those which hinder progress in the economic or political fields Health administrators, in recognising the essential similarity of health problems in different countries and in different areas, and the value to all of the experience of particular administrations, have come to recognise also the responsibility of co operation and of placing at the disposal of all the special information and experience which some have gained

The success of international as well as of national health work is, however, so closely connected with economic, financial, and social conditions that to select only one of these factors for study and action would be to invite failure Such considerations alone would suffice to connect the work of the Health Organisation with the main stream of international co operation which is developing through the League of Nations

At a recent session of the Health Committee, Dr Madsen, Director of the Danish State Serum Institute, who has been chairman of the Committee since its foundation, submitted a memorandum reviewing the present position of the Health Organisation in the light of its ten years' work and suggesting the lines of future development The very success of this form of international co-operation, and the fact that certain branches of the work are tending to assume a permanent character, make it highly desirable that the work of the Health Organisation should be directed along generally approved lines of policy

The study and collection of information is a branch of activity of which the Singapore Epidemiological Intelligence Bureau and the compilation of public health statistics are outstanding examples, and represents a phase through which every branch of the League's health activities, including even the activities of its Epidemic Commission in Poland in 1920, has to pass

Investigations lead in due course to the formation of general opinions and the elaboration of certain principles and recommendations for action The work of the Permanent Standardisation Commission in establishing and maintaining uniform international standards and methods of testing for serological and biological products is an example of

this stage, which is tending to assume permanency because such work must be continuous in order to keep in touch with developments of scientific technique and thought Similarly, the lengthy regional studies carried out by the Malaria Commission in Russia, south eastern Europe, the Mediterranean countries, and in India, as well as in the Mississippi basin, have led to an agreed general programme of anti malaria measures, while the plans for epidemiological study and administrative action which are now under discussion will require at least three years to complete The Sleeping Sickness Commission has already made some progress in the study of a disease which has hitherto defied the independent national efforts of African administrations, but a considerable period of international study and co operation will undoubtedly be required before sleeping sickness can be brought under adequate control in tropical Africa The Leprosy Commission, after a preliminary world survey of leprosy conditions, has, however, only just commenced its real work, and even certain partial studies, such as those on scarlet fever and diphtheria, are yet incomplete

Such scientific work and the continuous liaison work with health administrations, notably the system of interchanges or study tours for public health officers, are, of course, the main feature of the work of the Organisation Their development must inevitably tend to stress the third stage of activity of the Organisation, the initiation of action upon the lines indicated by the data obtained

Primarily, of course, action is a matter for the individual health administrations, but in recent months the Governments of Greece, Bolivia, Bulgaria, and China have all sought the technical advice and assistance of the League Health Organisation in elaborating plans or policies for health reconstruction work One of the chief developments of the Health Committee's work will undoubtedly lie in its collaboration with Governments seeking technical advice, and in the elaboration of a suitable administrative and medical technique

The advisory opinions given in this way represent essentially a declaration of the present state of knowledge and practice in particular fields of public health They are based on the pooled knowledge and experience of leaders in public health and medical research, and are, as Dr Madsen points out, needed in a number of fields of investigation at the present time Notably this is true in regard to maternal and infant welfare The infant mortality inquiry has led to the collection of a large amount of information, and a general report on the subject would be invaluable, not only to the South American States who extended the scope of inquiry at the Monte Video conference, but also to other countries anxious to organise national campaigns against infant and maternal mortality

Here, as in the case of such social diseases as cancer, rheumatic fever, heart disease, against which sanitary administrations have been compelled to take action in the last two decades, an analysis of the reasons which have led different countries to adopt specific measures, the determination of the degree of agreement existing on such measures and of the points where diversity of practice suggests further investigation, would be of very material assistance A series of reports of this type, properly prepared, would set out in detail the modern practice of preventive medicine and should furnish a basis for the study of the relations between public health services and health insurance

Similarly, the survey of medical schools and education in which the Organisation is assisting in China is another field which cannot be omitted from the programme of the Committee, if its studies of public health conditions are to be complete, and this is notably true in regard to Colonial administration

The growth and success of the International Health Organisation are of outstanding interest to all who are concerned with scientific progress The Organisation represents a definite advance in international scientific co-operation There seems to be no inherent obstacle to the development of international co-operation along similar lines by other scientific workers There are, indeed, indications that this is a most hopeful line of advance by which scientific workers can assume their responsibilities of leadership An international scientific organisation, as the experience of the Health Organisation demonstrates, is able to express a technical or scientific opinion which is too important to be disregarded and accordingly receives due consideration with the economic, financial, social, or political factors involved

The lack of administrators qualified to evaluate scientific as well as other factors involved in social, political, and economic problems has been responsible for many of society's most acute problems to-day, and has not been without effect upon the course of the rationalisation movement in industry It is at least possible that the development of international co-operation of the character represented by the League's Health Organisation may assist in the production of this much needed type of administrator

The Significance of the Seventeenth Century.

The Seventeenth Century By G N Clark Pp xii + 372 (Oxford: Clarendon Press, London Oxford University Press, 1929) 15s net

THOSE who remember the brilliant chapter by Prof Whitehead on "The First Physical Synthesis", in "Science and Civilization" (Unity Series), will rejoice greatly in Mr G N Clark's volume Prof Whitehead said that 1642, the year of the death of Galileo and the birth of Newton, was one of the crucial points in the history of mankind It marked "the centre of that period of about 100 years during which the scientific intellect of Europe was framing the synthesis which has remained down to our own times the basis of science Our modern civilization is due to the fact that in the year when Galileo died, Newton was born Think for a moment of the possible course of history supposing that the life's work of these two men were absent "

Now Mr Clark, without labouring the point or even expressly announcing it—for he does not seem to have noticed the striking coincidence of the dates—yet manages to provide, in a masterly survey of the whole field, abundant and conclusive evidence of the truth of Whitehead's remark On all sides of life in the Western world the seventeenth century saw the growth of the new spirit of inquiry, observation, synthesis, and, above all, measurement, which are the marks of science and of which Galileo and Newton were the greatest exemplars The great personal interest of Mr Clark's book lies in the fact that he comes to this conclusion without *parti pris*, as a professional historian trained rather on literary than scientific lines, but with an open mind and a supreme impartiality His book surveys the century from all points of view under topics, and without the accustomed political framework Politics and literature, of course, find their place, but only as two of twenty main subjects into which the matter is divided One might have thought that this would render reading less easy, but it is not the case The style and the selection and arrangement of the matter are so good that interest never flags

The chapters on science, philosophy, and other more specially intellectual things, do not take the first place, but we are led up to them through an account of the population, industries, constitutions, armies, navies, and colonies of the nations of Europe Then, near the end of the book, we reach the characteristic and most active force of the age, the scientific mind There is no attempt to press the connexion unduly or over-simplify the problem, but we see the same awakened intellect which in the outlying departments of practical life was ordering the national States, regularising armies, arranging postal services, and measuring and counting political and social facts, engaged at the centre in the supreme philosophic task of putting together the facts of the universe Undoubtedly, all these things are interconnected, and Mr Clark often shows the same man engaged both in purely abstract and in practical work, as Newton in the Mint or Grotius as ambassador What is so refreshing about his presentation is the attempt to give the whole in a manageable shape, allowing the salient points to appear above the details Of these points, two are most obvious, science and organisation We have spoken of the former, the latter is equally pervasive

The seventeenth century first made prominent in the West the tendency to knit society together, first nationally and then internationally, after the dispersive effects of feudalism and the religious wars of the sixteenth century Collective thought and action are the pre-eminent human qualities, and, on a certain plane and with certain intellectual presumptions, the Catholic Church had been achieving unity for many generations From the fourteenth century onwards, however, this work had been done more and more feebly and was at last completely interrupted The independent national sovereign States then began to take it up in a more drastic and comprehensive way Each State began to bring together, organise, and regulate the lives of its citizens with a thoroughness which an international Church had never been able to secure

Mr Clark exhibits for us the various spheres in which this activity was exercised by monarchs who, for this time and this purpose, needed to be practically absolute Hence arise the new and increasing standing armies, the organisation of government posts, the regulation of industry, the control of religion and education But, although the direction was largely governmental, it was by no means entirely so, and less in England and Holland than in other countries Combined effort of a more spontaneous kind was also a feature of the times, which saw the rise of joint stock companies and the great trading companies for exploitation abroad, such as the East India Company and a host of others, mainly English, French, and Dutch Though these and other activities were at that time and long after mainly national and aggressive towards other nations, we may trace the beginnings

of combination between nations in such spheres as diplomacy and international law, while, as Mr Clark reminds us, the end of the century witnessed the first definite joint consciousness of the West as against Turkey and the East since the Crusades

The eighteenth and nineteenth centuries were to see both these movements worked out to their logical conclusion First England and France and then England and Germany were to fight to the point of exhaustion for colonies and maritime supremacy, while the forces of co operation were gathering strength behind the scenes Our own times have seen the tragic outcome of the first process and the final apotheosis of the second

Mr Clark has not written with any propaganda in his mind, and for that reason the moral shines out the more clearly from his pages Readers of this review will turn with special pleasure to those parts of his book where he describes the beginnings of the apparatus which was ultimately to re-establish the broken contacts of the Middle Ages and make them stronger and more universal They will remember with gratitude that it was a man of the seventeenth century, Huygens the Dutchman, at home both in Paris and London, who gave as his English motto, "The world is my country, to promote science my religion" F S MARVIN

American Coal Mining

Transactions of the American Institute of Mining and Metallurgical Engineers (Incorporated) Coal Division, 1930 containing Papers and Discussions presented at Meetings held in New York, February 1928, February 1929, and February 1930 Pp 724 (New York American Institute of Mining and Metallurgical Engineers, Incorporated, 1930) 5 dollars net

THE American Institute of Mining and Metallurgical Engineers is one of the most important learned societies in the United States, and its *Transactions* have for many years taken very high rank amongst the world's technical publications Until quite recently, the *Transactions* took the form of one or two annual volumes, covering all branches of mining and allied technology, but recently a system has been introduced of collecting all papers dealing with one specific branch of the subject into one volume and publishing this by itself The present volume is the first volume of this kind, dealing exclusively with coal mining, and is the outcome of the papers and discussions presented during the years 1928, 1929, and the early part of 1930

It is quite natural that with the increase of complexity which characterises modern methods in nearly every subject, increased specialisation has become necessary, one outcome of such specialisation is the subdivision of the *Transactions* of the American Institute of Mining and Metallurgical Engineers into a number of separate divisions This system has its drawbacks as well as its advantages In the older volumes were to be found papers dealing with every branch of the whole wide subject, and an engineer interested in one section only, who turned over the volume to find papers on his special branch, could scarcely help seeing the others, he might even be induced to read them, and would probably find that every paper, however remote its subject might appear to be from the particular subject upon which he was engaged, would, nevertheless, throw some new light upon it and prove of some assistance to him This advantage he now loses under the new method His knowledge of the individual subject may, no doubt, become more profound than it was, but he necessarily loses that breadth of outlook which is one of the most valuable qualities that an engineer can cultivate

Persistence in the method symbolised by the volume now before us would undoubtedly lead gradually to the separation of coal mining from metalliferous mining, a separation from which engineers in Great Britain have suffered for long, owing in their case to statutory requirements The result has been that in Great Britain coal mining engineers were, generally speaking, ignorant of what was being done in metal mining, and vice versa, and appliances devised for use in one branch of the industry might remain for years unknown to the other, although it would be quite capable of finding useful application therein A case in point is the use of tables of the Wilfley type, devised originally for the dressing of ores in a relatively fine state of division Such tables have proved to be equally useful for the cleaning of small coal, but it was many years before British coal mining engineers learnt anything about the capabilities of such tables and attempted to apply them to coal mining needs

The volume under notice gives a useful epitome of the coal mining problems to-day in the United States and of the methods adopted for solving them There are, in all, some forty four papers, ten deal with coal mining, covering such subjects as ventilation, subsidence, and misfires, there are four papers on coal cleaning, three papers on coking, some nineteen papers on the classification

of coal, and a number of miscellaneous papers, including several which deal more especially with the methods of coal analysis It will be seen at once that the field covered is a wide one, and that the information contained in this volume is likely to be of great value to all coal miners, not only in the United States but also in Great Britain

We in Great Britain have already learnt a great deal from our coal mining friends in the United States, especially in matters relating to the mechanisation of collieries and the replacement of manual labour by mechanical appliances In the present serious condition of the British coal mining industry, it is quite evident that we shall necessarily have to progress much further along the same road, and British coal mining engineers will no doubt welcome the opportunity which this volume affords of learning how American coal miners are attacking problems which, after all, are more or less the same for both countries, although, having regard to the differences in natural conditions, they can never be quite identical In Great Britain, where, as already pointed out, coal mining and metal mining are necessarily separated from each other by a legislative barrier, a volume devoted entirely to coal mining will, no doubt, be welcome and will prove a great advantage Whether the artificial setting up of such a barrier in the United States, which this volume indicates, will be equally beneficial to American mining engineers may, for the reasons already stated, be open to doubt

Quantum Mechanics

(1) *An Outline of Wave Mechanics* By N F Mott Pp vi + 156 (Cambridge At the University Press, 1930) 8s 6d net

(2) *The Physical Principles of the Quantum Theory* By Prof Werner Heisenberg Translated into English by Carl Eckart and Frank C Hoyt (The University of Chicago Science Series) Pp xii + 186 (Chicago University of Chicago Press, London Cambridge University Press, 1930) 8s 6d net

(3) *Quantum Chemistry a Short Introduction in Four Non Mathematical Lectures* By Prof Arthur Haas Translated by L W Codd Pp ix + 77 (London Constable and Co, Ltd, 1930) 6s net

THE new theories of physics grouped under the title of 'quantum mechanics' are at present passing through a further stage in their development, in which the expositor is following close on the heels of the original investigator It is all to the good to have these less technical and less involved accounts of the theories

(1) Mr Mott, who is lecturer in theoretical physics in the University of Manchester, has written a book which will be of great value to a student who has completed an honours course in physics and wishes to understand the principles of wave mechanics Employing mathematical methods which should be familiar to such students, the author seeks to expound the general principles of the new quantum theory Extensive use is made of analogies from different branches of physics, and the result is a book which may be recommended to the advanced student of experimental physics and to the research worker It seems strange that the name of de Broglie is not mentioned on the first page along with the names of Heisenberg, Schrödinger, and Dirac, but the author makes amends on page 8 by calling the waves which represent certain of the properties of electrons de Broglie waves The purely symbolic character of these waves is insisted on from the outset, the fundamental assumption of wave mechanics being that our knowledge of the position and velocity of any particle can be represented by a wave "All that can be known about the electron in a hydrogen atom is summed up by the behaviour of a wave"

(2) As Prof A H Compton remarks in a foreword to this English edition of Heisenberg's work "The 'uncertainty principle' has become a household phrase throughout our universities, and it is especially fortunate to have this opportunity of learning its significance from one who is responsible for its formulation" In all experimental methods of making measurements of small scale phenomena there are limitations imposed by the interaction between the process of measurement and the measuring instrument, and it is the formulation of these limitations which constitutes the principle of indeterminacy The book is by no means an easy one to read, but there is no doubt that it will take an important place as an authoritative statement of Heisenberg's views on this aspect of the quantum theory

(3) In this book Prof Haas gives a short account of modern quantum theory in the form of four lectures for chemists In the first lecture he deals with the arithmetic of the periodic classification and describes the four quantum numbers required for the interpretation of line spectra The second lecture is concerned with the quantum theory of valency and chemical forces After an account

F 1

of London's theory of chemical combination, the difference between heteropolar and homopolar compounds is explained A digression on the subject of wave mechanics is followed by the hypothesis of Heitler and London that homopolar compounds of elements are due to the coupling by means of resonance of two similar atoms The third lecture is concerned with electron grouping and the periodic system, and is based on Pauli's principle The last lecture is of special interest, for in it the author discusses quantum problems of molecular and nuclear structure We find that the new mechanics gives an interpretation of radioactive disintegration as a chance phenomenon without any special hypothesis This gives us a beginning of a quantum theory of the nucleus This all too brief volume provides a convenient summary of recent theoretical work

Inorganic Chemistry

A Text Book of Inorganic Chemistry for University Students By Prof J R Partington Third edition Pp viii + 1083 (London Macmillan and Co, Ltd, 1930) 15s

THE third edition of this excellent text book will be as welcome as were its predecessors Compared with the first issue, which appeared in 1921, the biggest change made is the substitution of the original last chapter which dealt with the radio elements and atomic structure, by one of about three times its length, which is inserted earlier in the work, immediately after the elementary treatment of the Periodic Law Commencing with cathode and positive rays this new chapter (xxv — The Structure of the Atom) introduces the conception of isotopes, proceeds to discuss in turn X ray crystal analysis, atomic numbers, and radio active phenomena, touches on the Rutherford Bohr conception of the atom and the artificial disintegration of elements, deals with the octet theory of G N Lewis, different types of linkage, and quantum numbers, and concludes by a discussion of atomic structure, the periodic table, and valency, reference being made, *inter alia*, to the work of Grimm and of Fajans, and to wave mechanics

The book as a whole remains essentially as before, and displays all those qualities of clear, concise, restrained and yet fresh treatment which have justly led to its wide popularity in recent years The historical notes in the earlier chapters are particularly attractive, and the sponsorship of the author is a guarantee of their accuracy

The detail has been brought up-to date—thus, the oxides of bromine and of fluorine, chlorine fluoride, and chlorine hexoxide are mentioned Brief reference is also made to such matters as the connexion between energy and mass, cosmic rays, ortho and para hydrogen atomic hydrogen, active nitrogen, the adsorption theory of Langmuir, the shapes of molecules, the Debye-Hückel theory of strong electrolytes, and the quantum theory of specific heats

Opinions will differ as to the desirability of the mention of, at all events, some of these topics, as of those in Chapter xxv, in what is designedly a relatively elementary book, even when admitting that a judicious use has been made of small type (which, incidentally, has helped to keep the size of the volume sensibly as in previous editions) With intelligent students *and* teachers, there should be no trouble in other cases, there is an obvious danger that, when used as "a reference book for higher forms in schools", a type of instruction in chemistry may be fostered which university teachers are practically unanimous in deploring There are few other points open to any criticism The statement, however, on p 198, that the photochemical union of hydrogen and chlorine "when once started, goes on spontaneously", is misleading if taken away from its immediately preceding context

Our Bookshelf

Forestry a Study of its Origin, Application and Significance in the United States By Prof Arthur B Recknagel and Prof Samuel N Spring Pp xii + 255 + xxxvii (New York and London Alfred A Knopf, 1929) 10s 6d

IN this book, the two authors, well known members of the staff of Cornell University, set out to discuss the present day economic problems of the forestry question in the United States They state that they were encouraged to undertake the work by "the tremendous interest which many people have taken in the country's forestry problem, and by the need of orienting the public, particularly the younger generation in schools and colleges, in the important economic aspects of this problem" These words might equally well have been written for Great Britain, with the exception that instead of having the forestry problem restricted to one country, ours is scattered all over the world, the most important work being outside the small island of Great Britain

The book under review is in no sense intended as a compendium of forestry information nor is it a manual of methods Its sub title explains the aims of the authors Some of the economic problems of present day forestry are common to many parts of Europe, the biggest one being the question of the possible shortage of coniferous softwood supplies The position of the United States, that great

exploiter of coniferous forests during the past half century, is well known in this respect Inter-State imports have been proceeding for some time past, and the United States will for some decades to come import forest produce on an increasing scale From the British point of view, perhaps the first two chapters of this book will prove of greatest interest The first, "How Forestry came into being", gives us an excellent summary of the various stages the forests and forestry in the United States have passed through since their utilisation by the white man first commenced In the second chapter we are shown how the early movement towards forest protection and conservation ran parallel with the immense economic development of the forest industries, the merging of these two great movements being discussed in subsequent chapters The second half of the book deals with the introduction of principles and methods of forestry with the advent of the trained forester, with education and research, and the real status of forestry in the United States administration The authors may be congratulated on the way they have handled their material and presented it to the public

Beiträge zu einer einheitlichen Auffassung gewisser Chromosomenfragen mit besonderer Berücksichtigung der Chromosomenverhältnisse in der Spermatogenese von Alydus calcaratus *L* (*Hemiptera*) Von Enzio Reuter (*Acta Zoologica Fennica*, 9) Pp viii + 487 + 8 Tafeln (Helsingforsiae Societas pro Fauna et Flora Fennica, 1930)

THIS work is a careful cytological study of spermatogenesis in a Hemipteran insect, but it is much more, for it includes a discussion of literature in all the related fields of plant and animal cytology After some sixty pages giving a critical account of spermatogenesis in this insect, the remainder of the volume is devoted to a discussion of such questions as the structure of chromosomes, hypotheses of chromosome phylogeny, chromosome persistence and composition, the 'resting' period between mitoses, chromosome splitting, the method and meaning of chromosome conjugation, the nature of genes, and other questions The views and observations of others are freely cited, making the work a very useful one in comparative cytology

The questions considered are much too numerous to discuss here, but it may be mentioned that in the spermatogonial nuclei of *Alydus* the chromosomes split in the prophase The somatic number is 13, consisting of five pairs of ordinary autosomes of different sizes, one pair of micro chromosomes, and the *X*, which, as usual, becomes compact at an early stage The oogonial divisions show two *X*-chromosomes

Some of the drawings of chromosomes are made from the living cell There is no continuous spireme or bouquet stage, but the long chromosomes in meiosis pair laterally, beginning at one end, to form five gemini Remaining attached at one end, they afterwards diverge until they are end-to-end and then split lengthwise Before reaching their definite shape in diakinesis, they pass through characteristic extended (chromomere) and diffuse stages But it is strongly emphasised that from the last spermatogonial telophase to diakinesis all the chromosomes maintain strict genetic continuity as separate and distinct individuals The *X* chromosome is seen *in living cells* to be composed of four segments

All biologists wishing a critical summary of the present position on these cytological questions will find this work useful The bibliography alone occupies more than a hundred pages R R G

Einführung in die Bodenkunde der Seen Von Einar Naumann (*Die Binnengewässer Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten*, unter Mitwirkung von Einar Naumann und herausgegeben von August Thienemann, Band 9) Pp ix + 126 + 7 Tafeln (Stuttgart E Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G m b H, 1930) 16 gold marks

THE part of 'Die Binnengewässer' before us deals exclusively with lake bottoms It is a large and interesting subject and very thoroughly handled from all aspects The study of fresh waters as undertaken at the present day is a comparatively recent branch of science, and there has arisen, with its growth, a number of new terms, mostly introduced by the Swedish school at the Limnological Laboratory Aneboda, of which Dr Naumann is director This laboratory is a model for all such fresh water research Most of these terms have come to stay, although many of them have no English equivalent Good definitions are given throughout the work The chapters deal with the development and origin of the various bottoms, their layers and zoning, principles and methods of sampling, with descriptions of apparatus, the botany and zoology of the layers, including bacteria and the organic and inorganic deposits All these are carefully classified and described *Bodenkunde* is the study of the origin, qualities, and changes of the bottoms In it, geology, zoology, and botany are all involved, besides physics and chemistry It is an extremely important part of the larger and wider study of fresh waters in general This volume is indispensable to all those engaged in such researches, and is one of the most interesting of the series It is illustrated by photographs, maps and text figures which are good and well selected

A Century of Wood Preserving Edited by Sir Harold Boulton Pp x + 150 + 3 plates (London Philip Allan and Co, Ltd, 1930) 8*s* 6*d* net

AT the present time, when a renewed interest in the scientific study of wood preservation is being shown in Great Britain, it is well to recall that this country was a pioneer in this work, and the method of forcing antiseptics into timber by means of pressure in a cylinder was patented by Bethell so early as 1838 "A Century of Wood Preserving", edited by Sir Harold Boulton, contains the substance

of a paper read in 1884, before the Institution of Civil Engineers, by his father, Mr S B Boulton, who gave a complete and valuable survey of the progress made up to that date An account of the discussion which followed is reprinted and makes interesting reading, reminding us that the theory of the action of preservatives which was attributed to the coagulation of albumen was not yet dead at that date

Recent developments are briefly summarised by Mr Hubert Fergusson, and in the numerous appendices are reprinted some of the original patents and early papers referring to the action of preservatives The history of wood preservation has been one of trial and error, but advance must always be slow in work where results from practical experiments do not become available for many years Accurate scientific investigations are now beginning to take the place of empirical conclusions which have long been accepted as facts The experience of the past is apt to be forgotten, and the volume under review is of value in recalling to us the work achieved and the considerable knowledge of the subject that had been gained half a century ago The name of Boulton has long been associated with the progress of wood preservation, and it augurs well for the success of the newly formed British Wood Preserving Association that its first president should bear the name of the editor of this book

The British Journal Photographic Almanac and Photographers' Daily Companion, with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1931 Edited by George E Brown Pp 748 + 64 plates (London Henry Greenwood and Co, Ltd, 1931) Paper, 2s net, cloth, 3s net

BESIDES the usual epitome of progress, formulæ, tables, and miscellaneous information, this volume includes concise essays on the makers of photography, modern enlarging, and colour photography, with a note on bromoil The "Makers of Photography" is by the editor, and is a history of the development of photography from the earliest times up to approximately 1890, though, as might be expected, the last twenty or so years of the period is very sketchily done The value of this article lies in the history of the earlier periods, practically the first half of last century, as certain items which have only recently come to light are duly incorporated for, we believe, the first time The other articles also are excellent summaries of the subjects with which they deal

The advertisements, which are a very valuable section of the work, show what great advances have been made in the development of the apparatus for cinematography Lenses are now provided for it up to the extraordinary aperture of *f*/1, and cameras costing from a few pounds up to £250 or more

The "Gravure Pictures" are not of scientific value, but a considerable number appear to us to have been made from very much under exposed negatives However, that appears to be the fashion at present

Photo electric Cells and their Applications a Discussion at a Joint Meeting of the Physical and Optical Societies, June 4 and 5, 1930 Editor Dr John S Anderson Pp 236 (London The Physical and Optical Societies, 1930) 12s 6d

A descriptive account of the discussion on photoelectric cells arranged by the Physical and Optical Societies appeared in the issue of NATURE for June 21, 1930 This volume contains the original papers contributed by various authors, together with the general discussion which took place at the meetings at the Imperial College of Science and Technology The subject affords an excellent illustration of the importance of research in pure science, as few of the original workers in the subject of photo electricity could have anticipated the various technical applications which have arisen in connexion with their discoveries Not only in photometry, but also in connexion with such diverse problems as talking films and photo therapy, photo electric cells have been employed, and the successful solution of the problem of television is probably to be found through their use The relative merits of different types of cell provided material for much discussion, but as the sensitivity of a cell is largely a matter of definition, no general agreement was reached It is probable that the rivalry between the alkali metal cell and the selenium cell will continue, as each type seems to possess advantages for special purposes Although theoretical questions were not the main subject of the discussion, some interesting papers were contributed dealing with the theory of photo electric action, notably Dr N R Campbell's paper on selective photoelectric emission

The American Annual of Photography, 1931 Vol 45 Edited by Frank R Fraprie Pp 292 + Ad 64 (Boston, Mass The American Photographic Publishing Co, London Sands, Hunter and Co, Ltd, 1930) Paper, 7s 6d, cloth, 10s 6d

OF the twenty nine literary communications to this 'Annual', we note specially Dr Wightman's discourse on "Light and Matter", in which he traces the history of the subject and describes the theories at present held, and Dr Maximilian Toch's "Scientific Photography of Oil Paintings" Dr Toch demonstrates by examples that experts cannot judge of the condition of a painting from a photograph of it, "because it depends entirely upon how the photograph was taken as to whether the picture appears good or not" He gives some of the results of his prolonged experience Mr Neblette, as in previous years, contributes a review of the progress in photography for the past year The very large number of formulæ given are for the most part set forth in convenient tables, which save space and facilitate reference and comparison As the illustrations claim to be pictorial, we hesitate to remark upon them, but the under-exposure in many cases, and in some a slaty fog that covers the whole and is particularly conspicuous by artificial light, do not commend themselves to us as good photography.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

A Method of Measuring Upper Atmospheric Ionisation

THE experimental investigation of the electrical structure of the upper atmosphere by means of wireless waves as the exploring agency has shown that there exist two main ionised regions from which such waves may be reflected The lower of these regions is the Kennelly Heaviside layer, which reflects long waves in long distance transmission The upper region is found to be much richer in ionisation than the lower so that if we project vertically upwards waves of gradually increasing frequency (and therefore gradually shorter wave length) we find that, at a certain critical frequency, the lower region is just penetrated and reflection takes place from the upper region

In experiments carried out during the last twelve months it has been found that the value of this critical frequency is surprisingly definite and therefore can be taken as a measure of the ionisation content of the lower region

The relation between the critical frequency f and the value N of the maximum number of electrons per cubic centimetre can be derived as follows Waves sent into a medium of gradually increasing ionisation are reflected at a region where the refractive index μ tends to zero For a magneto optical medium such as the upper atmosphere I have shown (*Proc International Union of Radio Telegraphy*, vol 1, part 1 1928) that such conditions are reached for any direction relative to the earth's magnetic field H_0 when

$$\text{either} \qquad \mu^2 = 1 - \frac{\dfrac{Ne^2}{\pi m}}{f^2 + \dfrac{1}{3}\dfrac{Ne^2}{\pi m}} = 0,$$

$$\text{or} \qquad \mu^2 = 1 - \frac{\dfrac{Ne^2}{\pi m}}{f^2 \pm ff_H + \dfrac{1}{3}\dfrac{Ne^2}{\pi m}} = 0,$$

according to the polarisation of the waves Here e and m are the electronic charge and mass, and f_H is equal to $\dfrac{H_0 e}{2\pi mc}$ The results of an experimental study of the polarisation of downcoming waves (*Proc Roy Soc*, A, vol 117, p 576, 1928) lead us to adopt the second equation with the upper sign for ff_H The relation between the maximum electronic content N and the critical frequency is therefore

$$N = \frac{3\pi m}{2e^2}(f^2 + ff_H)$$

In experiments carried out between the emitting station at the National Physical Laboratory, Teddington, and receiving stations at King's College, London, and the Radio Research Station, Datchet, a technique has been developed which permits one determination of the critical frequency in a period of an hour, and we have reason to believe that, with still more experience on the part of the observing personnel, this period can be reduced to half an hour

A recent twenty four hour run using this method has shown that for a mid winter day over southern England the value of N reaches $2\ 0 \times 10^5$ electrons per c c at noon, after which the value falls steadily and remains at the low value of 3×10^4 during the greater part of the night About half an hour before sunrise a very sharp increase is noted, after which the ionisation increases more gradually until the maximum midday value is again reached The noon value of ionisation is thus found to be more than six times the midnight value

The diurnal variation curves bear a pronounced resemblance to theoretical curves deduced by Prof S Chapman (*Proc Phys Soc*, vol 43, part 1, p 26, Jan 1931) for a case of atmospheric ionisation by monochromatic radiation

The experiments have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research

E V APPLETON

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London W C 2, Jan 18

The Meaning of Existence

OTHERS perhaps besides myself may have regretted that the recent correspondence between Sir Oliver Lodge and Sir James Jeans should have closed just at the point at which questions were raised by it that go far beyond the actual issue between these distinguished physicists, and yet may have an important bearing upon it Asked whether ether *exists*, Sir James sums up his attitude to the question in the words, "nothing in science seems to exist any more in the good old fashioned sense --that is, without qualifications, and modern physics always answers the question 'To be or not to be?' by some hesitating compromise, ambiguity, or evasion" (NATURE, Dec 6)

To those approaching the question from the side of metaphysics rather than of physics this conclusion is likely to seem one of the most interesting outcomes of present day discussions as to the status of physical reality Physics seems here to have arrived by its own path at the position made familiar to philosophers in the last generation in America by William James in the brilliant section of his " Principles of Psychology " which deals with " The Many Worlds ", in England by F H Bradley in the chapter in 'Essays on Truth and Reality " entitled " On my Real World " These writers approach the subject from different sides James characteristically being concerned with 'belief', Bradley with 'reality', but one point which they have in common is precisely that of Sir James Jeans, namely, that before there can be any talk of existence you must define the world within which it is affirmed—what the logicians call 'the universe of discourse' within which your proposition falls Is it, for example, the universe of ordinary sense perception, defined by Bradley as that which is "continuous with the felt, waking body", or is it one of those 'sub universes', as James calls them, though 'super universes', in some cases would be a better word—the world, for instance, of history in which Julius Cæsar or of poetry in which Hamlet lives and moves and has his being ?

It is, however, not merely a question of different worlds Within the same world [illegible] mbiguity breaks out In the world "conti[illegible] th the felt, waking body"—the world, for ex[illegible] of the pen I hold in my hand and the action t[illegible] moves it—there is the difference between the appearance in time and space, the 'here' and the 'now' and the enduring system of atomic events in the pen, of habits and disposit[illegible]

in the movement If existence means what is all here and now, it is difficult to see in what sense these latter, the essence of which is just not to be all here and now, can be said to exist If, on the other hand, it means that which appears or expresses itself in what is here and now, it is difficult to see how we can assign more to the here and now than the shadowy form of the really existent Finally (and this brings us back to what Sir James Jeans has probably in view) we have the difference between the particular and the universal, in the ordinary sense the difference (to confine ourselves to the physical) between the pen and the law of its mass, where the same difficulty again meets us—the difficulty that has engaged philosophers from the time of Plato to the present day, and has led some of them to deny existence to that which appears to sense except as 'the moving image' or perceptible embodiment of an intelligible essence

Whether these distinctions throw any light on the controversy as to the existence of ether it is not for a mere metaphysician to say But it suggests at any rate that while those who maintain its existence may be making a mistake in thinking of it in terms of something that is continuous with the world of the felt, waking body, or as something that can be said to fill space they yet may be right in insisting that the word stands for an element in that world which the resolution of it into mathematical symbols or 'pointer readings' fails to make intelligible What is emerging more and more from the treatment of the world of sense perception from a philosophical point of view, is that, do what we can by our constructions, algebraic or other, to express it in conceptual terms there remains, as a surd, an element of inexpugnable givenness which must be taken not only as 'existent' but also as the source of the real existence of every thing else belonging to that world

Other questions of interest both to the physicist and the metaphysician are suggested by Sir James Jeans's reply chief among them the sense in which he would admit the existence of what it has come to be fashionable to call 'values' of which truth beauty, and goodness are stock examples Do these, as some things he has elsewhere said seem to imply, occupy a world apart from existing things? Or are they, as Prof Whitehead insists, a side of them apart from which no intelligible account can be given of them? But this is another story carrying us far beyond the particular point to which the discussion refers

J H MUIRHEAD

Dyke End,
Rotherfield Sussex,
Jan 11

Meteorological Conditions during the Air Raid on London, Oct 19-20, 1917

IN NATURE of Nov 29 1930, p 847, Col E Gold, discussing upper air conditions, states that the note under 'Historic Natural Events", in NATURE of Oct 18 1930, p 633, gives a misleading impression of the cause of the high winds at an altitude of 10,000 20,000 feet on Oct 19-20, 1917 A true explanation of the air structure which led to the loss of four German airships is of some importance though not bearing directly on the loss of the *R101* In "Aids to Forecasting" (M O Geophysical Memoirs No 16) types IV and VI are listed for Oct 19 and 20, 1917 The former shows '*lows*' north west and north east of the British Isles, and the latter an advancing '*low*' with characteristic pressure gradients For Oct 21 the type indicates a deep V-*low*

Col Gold is of opinion that although there was no pressure gradient at sea level, there was a steep west to east gradient at great heights, due to a steep horizontal gradient of temperature also from west to east Such a wind was a thermal wind only, and surface pressure "had nothing to do with the case" Trustworthy records are meagre, and the argument for the assumed steep horizontal temperature gradient and thermal wind rests mainly upon a record at Ipswich on the forenoon of Oct 20, which shows an isothermal condition at 4400 metres The case is discussed by Sir Napier Shaw in his "Manual of Meteorology", part iv p 112, and it may be that the record rightly tells of the remnant of a tongue of relatively warm air passing east The important point, however, is that at the ground there was little or no wind, and with clear skies radiation had full play There was no convection, and so a characteristic ground radiation fog formed In other words, there was a temperature inversion in the lowest level, whatever happened above London had no need of anti aircraft guns that night Its citizens slept in quiet, unaware that four of a fleet of eleven airships were overhead laden with bombs Nature provided a defence which cost nothing, was noiseless, and thoroughly effective

The whole story of that great air raid will probably never be made public Owing to failure of radio and loss of touch with Nauen, the ships went astray From midnight to 7 A M of Oct 20 they moved south east instead of east, unaware apparently of drift, unless the course was in error If there was a northerly wind at 4400 metres it had little or no strength at lower levels, and the airships probably flew low for several hours, seeking to penetrate the fog and locate themselves What saved London was not the northerly wind at high levels but radiation fog at the surface For forecasting purposes in connexion with aviation, the likelihood of fog at low levels would seem to be a matter of prime importance

ALEXANDER MCADIE

Blue Hill Observatory,
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I THINK Prof McAdie's view of the vital importance of fog in aviation will command general assent, and I am not acquainted with anything contrary to his suggestion that fog prevented the German airships finding their objective on the occasion in question This, however does not explain why the airships drifted so far south and failed to return to their bases The strong northerly winds at great heights, of which the ordinary weather maps of surface conditions gave no definite indication do furnish a reasonable explanation of this fact

I do not think the existence of these northerly winds admits of doubt they were actually observed by pilot balloon in north east France on the night of Oct 19, 1917, at a height of 14,000 feet Nor do I think there is any doubt about the existence of the steep horizontal gradient of temperature with the distribution of surface pressure which existed at that time, there could not have been strong northerly winds at great heights without a steep horizontal gradient of temperature The question on which there may be difference of opinion is, whether the northerly winds were the cause or the effect of the horizontal gradient of temperature (if one can speak of cause and effect in connexion with phenomena which must co exist and which must develop together)

E GOLD

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Separation of Bitumen from Bituminous Sands

THE separation of the bitumen from the Alberta bituminous sands by washing with hot water has been under study by the Research Council of Alberta for a number of years. It has been found that generally good separation can be effected by first thoroughly mixing the bituminous sand with about one fifth of its weight of a solution of commercial silicate of soda of 2 per cent or less concentration, heating the mixture to a temperature of about 85° C., and then introducing the bituminous sand thus treated into a body of hot water also at a temperature of about 85° C. The bitumen collects on the surface of the water as a froth. Runs through our laboratory separation plant using recently mined bituminous sand of from 10 to 17 per cent bitumen content yield separated bitumen containing 5 per cent or less of mineral matter. However, in spite of careful control of ordinary factors, such as temperature, quantity and concentration of reagents, time of treatment, rate of feed, etc., it has not seemed possible to duplicate results closely. Two batches from the same supply of bituminous sand might give separated bitumens containing 1 and 4 per cent of mineral matter, although care had been taken to separate them under similar conditions.

Last summer we operated a 25 ton per day separation plant at the bituminous sand deposits in Northern Alberta. Bituminous sand from some parts of the quarry acted very badly in the plant and gave poor results. When such material was being run it was noted that the plant water became distinctly acid. Samples of bituminous sand were collected from various points in the quarry. These were stirred up in from two to three times their volume of water and the acidity of the water noted. The pH values varied from 2.5 to 6.4.

At a location some fifty miles distant from our plant a private party was separating bituminous sand by hot water. The separation plant was very crude and no treating reagents at all were being used. Yet separation results were apparently good. Water in which bituminous sand from this location was stirred gave a pH value of 6.4.

Supplies of sand from our quarry that had given varying degrees of trouble were brought to our laboratory at Edmonton. It has been found that if, in the preliminary treatment of the bituminous sand, alkali is added until the pH value of water in which a test sample of the batch has been stirred becomes 6.4 or higher, the treated material then gives excellent separated bitumen on washing in hot water. A series of runs shows steady improvement in the cleanliness of the separated bitumen as the pH value of 6.4 is approached, but little change as this value is passed. Sodium hydroxide and silicate of soda, both singly and in combination, have been used so far.

A preliminary washing of a refractory bituminous sand in cold water has the result of greatly diminishing the quantity of alkali which must be added to bring the pH value to 6.4. It also has the advantage of removing clay from the bituminous sand, if clay is present. Clay apparently has a bad effect on separation, as well as causing trouble by fouling the plant water.

The acidity in the bituminous sand is probably due largely to ferrous and ferric salts carried into the bituminous beds by ground water passing through the clayey overburden. Salt incrustations appeared on some parts of the face of our quarry. Analysis showed that this salt accumulation was a mixture of ferrous, ferric, aluminium, calcium, magnesium, and sodium sulphates.

A careful study of the effect on separation of adjusting the acidity of the bituminous sand in the preliminary treatment and of related factors is being made. The detailed results of the study will be published in due course.

K. A. CLARK.

Research Council of Alberta,
University of Alberta,
Edmonton, Alberta, Canada,
Jan. 6.

Nutritive Value of Benniseed

THE question of the nutritive value of benniseed (*Sesamum indicum*) was recently raised and analyses were carried out in this laboratory. This seed is grown along the Benue River and its tributaries by the various clans of the Munshi or Tiv people. A small amount of it is eaten and a little oil is extracted, but the bulk of the crop is exported, I gather, to Europe for the manufacture of 'salad oil' and the very fine grade machine oil called 'Sesame'. What happens to the 'cake' I do not know.

Analyses gave the following relevant percentages: Oil 52.6, protein 23.4, total ash 4.0, CaO 1.2, P_2O_5 1.39, from seed grown in the Yandev Area of the Benue Province. The Government Analyst, Mr. A. Hobson, has confirmed the calcium oxide percentage, but his phosphoric anhydride figure is 1.13 per cent.

All analyses of Nigerian soils so far carried out not by this laboratory show exceedingly poor figures for calcium and phosphorus and so the percentages of these minerals in benniseed would be sufficiently astonishing on these grounds alone; but I can find no recorded analyses showing a higher calcium content for any food: cheese is 0.9, for example, and only New Zealand spinach and the leaves of the sweet potato seem to approximate to this exceedingly high figure; nor can I find any ash analysis of benniseed itself.

As previous work has shown[1] the natives of Northern Nigeria suffer from gross deficiencies of calcium and protein in their dietary, and so the importance of benniseed cake is at once obvious. Indeed, measurements of the boys in the Dutch Reformed Church's Mission School at Mkar show clearly, within the limitations imposed by the numbers, that the benniseed eating Munshi boy is shorter but heavier than the Hausa schoolboy.

There might be an even more important general point. It has become the fashion to discount soil analyses in some nutritional quarters, and to use instead the analyses of the crops that grow on the particular soil. Benniseed grown in the arid north of Katsina Emirate and from French territory contains 1.18 per cent of calcium oxide, and, therefore, it would appear that this plant exercises a strong selective absorptive power for calcium. There is no reason to believe that other plants will not show the same capacity. It might prove of value to soils poor in calcium and phosphorus to plant benniseed to concentrate these minerals, and then to plough in the flowering plant, or the dried plant after the crop has been reaped. I have just been informed that the Munshi women burn the seed bearing heads, after removing the seeds, and use the ash in their soups. This is a strong hint to analyse the leaves and the stem.

Green manure is firmly established as a way to increase available nitrogen and to prepare humus in arid regions, and so it might be worth while to attempt concentrating minerals in deficient soils, such as Northern Nigeria, by the same method. Such work must have been attempted somewhere, but I am unable to find any reference to it in the limited

literature at my disposal This letter may serve, I hope, to initiate such experiments, or to bring to our notice in Nigeria work already done

W E McCulloch

Dietetics Research Laboratory,
Katsina, Northern Nigeria, B W A,
Dec 18

[1] An Enquiry into the Dietaries of the Hausa and Town Fulani of Northern Nigeria, with some observations of the effects on the National Health with recommendations arising therefrom W E. McCulloch, *West African Medical Journal*, **3**, 1929–30

Determination of the Velocities of Projectiles by the Method of Light Interception

Messrs Payman and Woodhead appear to have misunderstood the method described in our letter in Nature of Dec 27, p 994 We made no claim to originality of application of the principle of light interception Our method does not depend on shadow or ordinary photography, which has been used in ballistics since the time when Boys took his first shadow photographs in 1893, and differs from that used in other optical chronographs (see, for example, Cranz, "Experimentelle Ballistik", **3**, chap ii, 1927), of which Kampé de Fériet's is one

Fériet's method consists in taking a continuous photograph of the projectile itself, by ordinary day light photography, on a plate moving at right angles to the direction of flight The records show a band at an angle to the direction of motion of the plate The velocity determination involves the measurement of this angle There are no discreet interceptions as in our records

In our method the motion of the film of the camera (which is a simple drum camera with a cylindrical lens at the shutter, not a 'photographic' camera in the ordinary sense) is parallel to the axis of flight The projectile eclipses one or more beams of light which are brought to a fine focus (less than one millimetre) on the line of flight, and it is these eclipses or interceptions of the beams by the body of the projectile in flight which are recorded, not the reduced shadow images of the projectile In Fériet's method there is no 'range' in the technical sense, in our method the 'range' is the accurately measured distance between the two foci of the interception beams on the line of flight Fériet's camera gives the ratio—velocity of projectile to velocity of plate—whereas our camera simply gives a time interval between the eclipses by the body of the projectile of two fine beams of light placed a known distance apart The difference is obvious when it is realised that a velocity determination can be made from Fériet's photographs alone, without other data, whereas from our photographs it is not possible to determine a velocity unless the 'range' is known

Since the publication of our original letter in Nature of Dec 27, 1930, we have learned through the courtesy of the Director of Ballistics Research, Woolwich, that a method on the same principle as our own was developed by Thompson, Hickman and Riffolt and published in the *Proceedings* of the U S National Academy of Sciences (*Proc*, **6**, 169, April 1920) These workers utilised a single narrow beam of light, whereas we utilise two finely focused beams the illuminating and recording apparatus is different but the principle is the same

James Taylor
Robert Wark

Research Department (Nobel Section),
Imperial Chemical Industries,
Stevenston, Ayrshire

Embryology and Evolution.

In the issue of Nature for Dec. 13, Mr. G. L. Purser gives us an analogy of the modern manufacture of motor cars as a contribution to the solution of the problem of embryonic evolution which is novel and interesting, but far from satisfactory

The comparison of the function of the hypothetical gene to that of an intelligent workman is but adding to the mystery Often the workman in the modern factory functions merely as the trigger-release of processes altogether beyond his ken, and subservient to the will and preconceptions of the motor car designer The more excellent the machine, the less dependent it is upon the control of the workman intermediary, but however excellent the machine, the sole origin of that excellence lies obscurely hidden in the phenomenon we term intelligence Devoid of motive power, the most excellent of all machines stands immobile It cannot move productively unless, again by some intelligence, a motive force is accurately applied, and the moment this force ceases to reach it, the machine stops

Most of us before we reach the age of ten have learnt that anything which 'goes' is driven by a force external, yet although we live to be a hundred, what a host of us regard with sublime abhorrence the suggestion that the same thing is likely to be true in regard to living cells! We willingly accept the validity of 'kinetic', 'electrical', gravitational', or other forces, but we dogmatically affirm that a 'vital' force is but a bogy from the limbo of fantastic superstition, and so we evoke the genie, perhaps the gene, and by its spell try to account for all we see—with as much success as if we claimed that the revolving flywheel of our motor engine were the real source of its motive power

Personally, I feel that incredulity of a 'vital' force is scarcely any longer compatible with true scientific observation Anyone who has studied mitotic division of the cell and is conversant with electro-physical phenomena feels instinctively that he is observing the action of a force strikingly similar to that of the magnetic field Irradiation with ultra violet light is found to augment the process of ovulation in the domestic fowl, while the reproduction of fur-bearing animals in northern lands is strangely correlated with magnetic solar radiation

Entelechy, like the word phlogiston, may be the signpost on the way to a new enlightenment, which will, I predict, ere long result in the acceptance of the view that the living cell is, after all, merely a machine primarily operated by some external force Even so, let us remember that vitalism and spiritualism are not synonymous

Malcolm E MacGregor

Wellcome Field Laboratory,
Wisley, Surrey

Use of Tungsten Arc Lamps for Photomicrography.

The uniform intrinsic brilliancy and compactness of the tungsten arc lamp have led to its extensive application as an illuminant for photomicrography It does not appear to be generally recognised, however, that the light which leaves the metal surface at angles approaching a tangent is so strongly plane polarised that it is difficult to obtain uniform illumination when crystals are being photomicrographed by plane polarised light

The polarised light emitted at an acute angle to the incandescent metal surface has its vibration direction parallel to that surface This effect may be shown by projecting an image of the incandescent tungsten sphere on to a white screen by means of a 2-inch objective, and then interposing a Nicol prism

in the beam of light, when the edges of the image parallel to the long diagonal of the Nicol are darker and those parallel to the short diagonal are brighter than the centre of the field By placing a '1st order red' selenite between the light source and the Nicol prism, the edges of the image appear red or greenish-blue according to their orientation with respect to the prism

The degree of lack of uniformity of illumination which can result when 'contrasty' photographic materials are used in photomicrography by polarised light, is shown in Fig 1, *a*, *b*, *c*, which are photographs

a *b* *c*

FIG 1

of the tungsten sphere of a Pointolite lamp. Fig 1*a* was the ordinary appearance in the absence of a Nicol prism, whereas Figs 1*b* and 1*c* show the appearance when a polarising prism was interposed with its plane of vibration horizontal and vertical respectively

This effect, which is not given by either a carbon arc lamp or the sun, could give rise to appreciable errors if a tungsten arc lamp were used for spectro photometry without the interposition of ground glass to form a secondary source

EDWIN E JELLEY

Research Laboratory, Kodak, Ltd,
Wealdstone, Jan 14

A Relation between the Radial Velocities of Spiral Nebulæ and the Velocity of Dissolution of Matter

I SHOULD like to make the following comments upon Dr McCrea's remarks in NATURE of Dec 6, 1930, upon my letter in NATURE of Nov 8, my comments also apply to a certain extent to Dr Wilhelm Anderson's letter in the issue of Dec 6

(1) As I have shown recently (*Anzeiger der Akad d Wiss Wien*, 1930, No 16), equation (1) can also be deduced without general relativity theory from the postulate that the total energy of the universe cannot be negative, or that the negative gravitational energy of the universe corresponds in magnitude with its proper energy By mass in equation (1) Eddington's proper mass is to be understood

(2) It is true that a negative velocity results, as Dr McCrea insists, I have, however, indicated this myself in my letter, where I showed that v agrees well with the radial velocity of the spiral nebulæ only in *magnitude*, that is, without reference to sign

(3) If, again, my equation (2) is to be interpreted from the point of view of Lemaître's theory, with introduction of a temporal variation of λ, then it must not be overlooked, on the other hand, that Lemaître's theory requires further assumptions to make it complete Such would, perhaps, be necessary to bring the assumption that the velocity becomes greater by $c/2000$ for every million light years' distance in agreement with the other assumption that the initial radius of the universe, calculated to be 1200 million light years, is doubled every 1400 million years, that is, within a time shorter even than the age of many minerals—not to speak of astronomical estimates of the age of the sun.

ARTHUR HAAS.

University of Vienna, Jan 3

Photographs of John Dalton.

I SHALL be glad if any readers of NATURE can assist me in tracing the present whereabouts (if still in existence) of three original photographs of Dr John Dalton These were taken in Manchester, at one sitting, somewhere about the year 1842, by the Daguerre process, then recently introduced into Great Britain, and so far as I know were the only photographs of the great chemist ever made Their production has been wrongly attributed to John B Dancer, the fact being that it was through Dancer's good offices that Dalton was induced to sit at the local Daguerre studio

It is on record that one of the three copies passed to Dalton himself, another to Dancer, and a third to Mr John Dale, manufacturing chemist Dancer's passed at the time of the Jubilee exhibition in Manchester in 1887 to Mr (afterwards Sir James) Dewar, the eminent chemist, I have also seen it stated that another (possibly Dale's) was in the possession of the late Mr Thomas Kay, manufacturing chemist, of Stockport There is no trace of such a photograph in the collection of Dalton's apparatus at the house of the Literary and Philosophical Society where he did so much of his work, nor in the more personal relics preserved at Dalton Hall

Dancer's photograph was lent by him on various occasions to artists and engravers for copying, and became somewhat disfigured in consequence

Perhaps this letter may meet the eye of someone who has actually seen one of the originals or can assist me in tracing them

HENRY GARNETT

3 Lea Road, Heaton Moor,
Stockport, Jan 19

The Black-necked Grebe

IN the note upon this bird (NATURE, Jan 3, p 35) its generic name is given as *Podiceps*, perpetuating an error in orthography for which, I think, Yarrell was originally responsible and has been followed by some later writers on ornithology On the analogy of *biceps*, *calviceps*, etc, *Podiceps* can only be translated 'rump-headed', whereas the right name of the genus is *Podicipes* (Linn), meaning 'rump footed', referring to the peculiar position of the legs and feet in birds of the family Podicipedidæ

HERBERT MAXWELL

Monreith

WERE all taxonomists as familiar with the classical languages as is Sir Herbert Maxwell, mistakes such as he points out would be rarer, but although they appear in Latin guise, generic and specific names need not be evolved from anything but the author's sense of propriety The name is a label and need have no meaning in itself The consequence of that, and of the accepted rule of nomenclature that the first legitimate christening holds the field, is that *Podiceps*, used by Latham in 1789 to designate our grebes, is now the accepted generic name

THE WRITER OF THE NOTE

Dimorphism of Long Chain Carbon Compounds

FROM recent X ray measurements (Malkin, NATURE, Jan 24, p 126) it is claimed that the ethyl esters of fatty acids may have two forms of chain An account of an investigation of several binary systems of C_{16} and C_{18} compounds will shortly be published, in which it is shown that the ethyl esters are dimorphous, ethyl palmitate melting at 19 4° or 24 15°, and ethyl stearate at 30 9° or 33 4°

J C SMITH

The Dyson Perrins Laboratory,
Oxford, Jan. 29

The Significance of Peking Man.*

By Prof G ELLIOT SMITH, F R S

THE brain-case found by Mr W C Pei at Chou Kou Tien on Dec 2, 1929, is the most significant and illuminating relic of primitive man ever recovered Prof H Fairfield Osborn, writing in *Science* of Feb 22, 1929, raises the possibility that Piltdown man may be so old as the Pliocene He claims that the dark-coloured fragments of the skull of *Eoanthropus* are intermingled with similarly coloured fragments of proboscidian molars of unquestionably Upper Pliocene age, and that it is not certain that *Eoanthropus* belongs to the Lower Pleistocene In the case of *Sinanthropus*, there is no such uncertainty as to the contemporary fauna, for the human remains were left on the floor of a cave and a vast number of the animals which roamed the region of Chou Kou Tien in these remote times left their bones in the same cave As all these fossils belong to the same geological epoch, the Lower Pleistocene, there can be no doubt of the age of *Sinanthropus*

The discovery, at Chou Kou Tien, of fossil teeth of Lower Pleistocene age which were identified as human, had made it evident that at the close of Tertiary or the beginning of Quaternary time man, or a very closely related anthropoid, actually did exist in eastern Asia This knowledge is of fundamental importance to students of human palæontology For in the same geological epoch *Pithecanthropus* was living in Java, *Eoanthropus* was roaming the region around Piltdown in England, and at Mauer, very shortly afterwards, the man of Heidelberg, *Palæanthropus*, represented the human family in Germany

In November 1928 additional remains of human skulls—further teeth, portions of two lower jaws and fragments of brain-cases—were found The peculiar features of the chin region of these jaws differed from those of all other known human specimens excepting only the Piltdown jaw, to which they present a general resemblance, without being generically identical There is a similar ape-like obliquity in the slope of the symphysis and traces of the simian shelf in the lingual aspect of the jaw Not only do these peculiarities emphasise the peculiar features of *Sinanthropus*, but they also afford welcome confirmation to the views of those who regard the Piltdown jaw as human

The skull discovered by Mr W C Pei was successfully freed from travertine after a labour of four months by Dr Davidson Black, and then disarticulated and reconstructed It is important not merely because it gives a much fuller idea of the exact form of the skull of an Early Pleistocene man (free from the doubts which arise in the case of a reconstructed specimen), but also because its peculiar features, revealing as they do many points which suggest an affinity with *Pithecanthropus*, associated in the same skull with others such as are known only in the case of the Piltdown skull, form a bond of union between the other two Early Pleistocene skulls, the characters of which hitherto have been supposed to be irreconcilable one with the other

In addition to this, the skull of *Sinanthropus* reveals many features which are unknown in either of the other types and throws a great deal of light upon the characters of the common ancestor of the human family, from which all these genera had been derived One of the most striking illustrations of this fact is the peculiar form of the mastoid region of the temporal bone, recalling as it does the condition found in the new-born child and in the adult anthropoid apes For it lacks that salient character which is so distinctive of the adult human being of other genera

The brain-case found in 1929 is that of a young adult corresponding in the state of its development with the condition found in modern human skulls at about eighteen years of age When the skull was first examined, Prof Davidson Black was impressed by the grace of its contours in comparison with the uncouth outlines of *Pithecanthropus*, and suggested the possibility that it might be female, with the reservation, of course, that the evidence at our disposal regarding this hitherto unknown type of being was altogether inadequate for any definite decision upon this matter

The discovery of another brain-case was made in July 1930 by recovering from material brought in from the Chou Kou Tien cave (in October 1929) a series of fragments which articulated naturally one with the other to form the greater part of the calvaria This discovery of a skull of another young adult of approximately the same age revealed a more lightly built skull with smaller eyebrow ridges, a less prominent forehead, and less obtrusive parietal eminences, which both Prof Davidson Black and I consider to be probably of a different sex from the other skull

One of the most remarkable points of contrast between the brain-case of *Pithecanthropus* and of *Eoanthropus* was the remarkable thickness of the latter, whereas the skull of *Pithecanthropus* was much thinner In the case of the skull of *Sinanthropus* found on Dec 2, 1929, the thickness of the bone (Fig 1) approximates to that of the Piltdown skull Not only does it resemble it in mere thickness, but also the architecture of the cranial vault (which in the case of the Piltdown skull has hitherto been regarded as quite distinctive) is almost exactly reproduced in the case of *Sinanthropus* In all other known human skulls the cranial bones consist of two fairly thick tables united by a comparatively thin layer of diploic tissue consisting of fine trabeculæ In the case of the thick cranial bones of both the Piltdown and the Peking skulls, the tables are relatively thinner, and the thicker layer of diploic bone consists of a very robust network of coarse trabeculæ These similarities suggest that in the thickness and peculiar texture of the cranial bone of two Early Pleistocene skulls of different type

* From the Henderson Trust Lectures (No 11), delivered in the University of Edinburgh on Jan 30

(separated geographically as their habitats were by the whole extent of the continental land mass

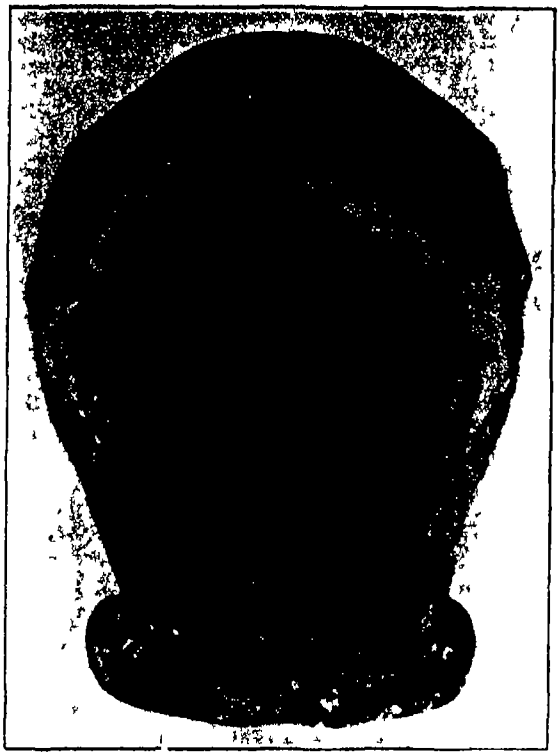

Fig 1 —Photograph of the upper aspect of the Peking skull with part of the roof removed to display the exceptional thickness of the bones and the small size of the brain cavity, which is occupied by a mass of limeston (travertine) The thickness and texture of the skull reveal an unexpected similarity to the conditions found in the Piltdown skull

between England and China) we are dealing with characters of primitive man for which no close analogy can be found in the apes This condition in the Piltdown skull was regarded either as pathological or the result of some freakish mutation But the presence of the same condition in *Sinanthropus* enhances its importance

Why the skull of primitive man should attain such an enormous thickness is difficult to explain but the evidence provides an interesting problem for morphologists to endeavour to solve Did primitive man's skull increase in thickness because the increase in the capacity of the brain-case deprived an increasing area of the protection of the temporal muscles?

For the moment, when there is no clear indication as to the meaning of this peculiar morphological feature, it is of interest as emphatic evidence of the affinity between *Eoanthropus* and *Sinanthropus* and of the enhanced importance of the structural peculiarity itself The contrast in thickness between the cranial vault in *Pithecanthropus* and *Eoanthropus* acquires a new interest in view of the fact that the three (adult) skulls of *Sinanthropus* (one of the fragments found in 1928 is thin because it is part of a child's skull) reveal a considerable range that is sufficient to bridge the gap which separates Piltdown man from the ape-man of Java

The discovery of the two jaws in 1928, presenting as they did features hitherto known only in Piltdown man, raised the possibility that there had been discovered in China a type of human being more closely akin to the Pleistocene man of England than that of the ape-man of Java, who was geographically much nearer to the Peking man When, however, in 1929 the skull was found (and the base was still embedded in the solid mass of travertine) the striking resemblances of the brain-case (Fig 2) to that of *Pithecanthropus* suggested that, after all, the newly found genus was more nearly akin to his neighbour from Java The skull revealed great projecting eyebrow ridges like those of *Pithecanthropus*, which provided a marked contrast to the condition found in Piltdown man, in which such ridges were lacking The front part of the skull was also flattened and ill-filled, and had a prominent median crest such as that of *Pithecanthropus* There was this difference in the frontal region of the bone, however, that the frontal eminences were definitely more obtrusive than those of *Pithecanthropus* Turning to the consideration of the parietal bones, one finds a close resemblance to those of the Piltdown man This resemblance depends both upon the fact that the bones tended to be raised up towards the middle line and are not so flat as those of *Pithecanthropus*, that there is a very definite parietal eminence such as is completely lacking in the Java skull, and that the postero-inferior corners of the parietal bones are everted in that peculiarly distinctive way found in the Piltdown skull The occipital bone again presents a much closer resemblance to that of *Pithecanthropus*, and when we turn to consider the temporal bones we find a much more primitive condition of the mastoid and of the tympanic bones

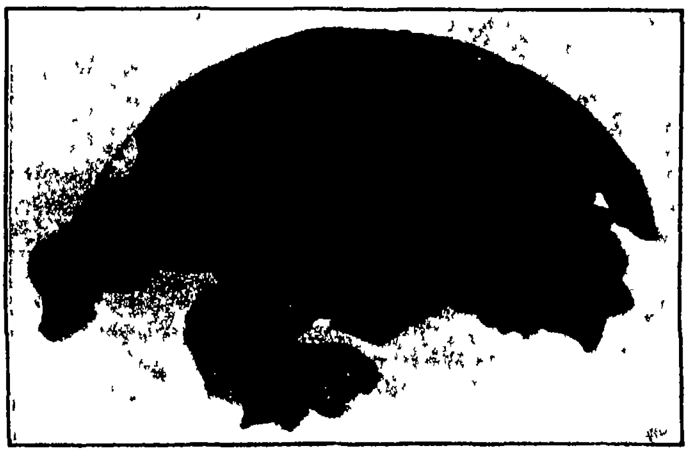

Fig 2.—The left side of a skull of Peking man found in July 1930 It shows the root of the nose and part of the base of the skull which were not present in the specimen found in December 1929, and it reveals certain minor differences from the other skull which have been interpreted as due to a difference in sex

than that which is revealed in *Eoanthropus* Unfortunately the temporal bone of *Pithecanthropus* has not yet been discovered, so that we cannot

institute comparisons between *Sinanthropus* and *Pithecanthropus* in this respect

One of the most interesting features of the specimen found in 1929, a feature which Dr Davidson Black inferred from the nature of the wear of the teeth long before the skull was found, is the fact that the condyloid fossa for articulation with the mandible presents a very close resemblance to the condition found in modern man, in size, depth, and direction This fact is all the more remarkable because in other extinct members of the human family, in particular Rhodesian man and Neanderthal man, there are much more profound differences in the under surface of the temporal bone The attainment of the condition which became a permanent factor in *Homo sapiens* suggests that *Sinanthropus* is a primitive generalised type, and that modern man has retained many of these primitive characters

Looking at the skull as a whole, one can say that its general form is intermediate between the conditions found in *Pithecanthropus* and *Eoanthropus* It enables us to unite into a solid foundation the characters of the three most primitive members of the human family at present known In giving coherence to this knowledge it also enables us to picture the nature of the common ancestor of all three, the as yet hypothetical Pliocene man

The suggestion has been made that the Peking man's distinctive features are not sufficiently pronounced to exclude him from the genus *Pithecanthropus* The whole configuration of the skull, the texture of the cranial bones, the morphology of the frontal, parietal, and occipital bones, as well as the distinctive features of the teeth and mandible, clearly differentiate Peking man from the ape-man of Java, and present a contrast which is so profound as to compel us to accord it generic distinction In many respects it differs from *Pithecanthropus* and resembles *Eoanthropus*, but the contrast to the latter is even more obtrusive It occupies an intermediate position between the two, but is more primitive and generalised than either

It is a very significant phenomenon that at Chou Kou Tien, in spite of the most careful search in the caves during the last three years, no trace whatever of implements of any sort has been found It must not be forgotten, however, that Dr Andersson in 1921 found pieces of quartz in association with the fossil bones, and that in the later stages of the excavation Mr Pei found further examples of this alien material Those who have been searching in vain for evidence of human craftsmanship on this site are being forced to the conclusion that the Peking man was in such an early phase of development as not yet to have begun to shape implements of stone for the ordinary needs of his daily life

Vitamin B

Distribution and Physiology

THE general distribution of vitamin B is now fairly well defined, but the adequacy of different food substances in this respect for different species and the distribution of the various factors in the B complex are still subjects for investigation R H A Plimmer, with W H Raymond, J Lowndes, and J L Rosedale, has examined the comparative vitamin B value of cereals, pulses, and nuts (*Biochem Jour*, vol 21, p 1141, 1927 vol 23, p 545 1929) The preventive method was employed, using pigeons, and the criterion was maintenance for at least 26 weeks All the vitamins required by the pigeon were therefore included in the estimation symptoms of deficiency were paralysis and loss of weight The diets used contained 5 per cent fish meal, white flour or white rice, and the substance under test in varying proportions Dried yeast contained most vitamin of the other foodstuffs, wheat germ was about half as good as the yeast, whole wheat, bran, and middlings contained about a tenth of the amount present in yeast, and other cereals about a twentieth The majority of the pulses and nuts examined contained between a fifth and a tenth of the quantity present in yeast More vitamin B is required for hatching and rearing young than for maintenance Chickens require half as much again as pigeons, rats only about half, the requirements of human beings may be intermediate between those of the pigeon and the rat

A L Bacharach and E Allchorne (*ibid*, vol 22, p 313, 1928) found that the vitamin B content of malted flour was the same as that of the original unmalted flour, but that the malt extract appeared to contain more the experiments were carried out on rats and the effect is attributed to the improvement in appetite brought about by the extract

The content of vitamin B in seeds has been shown to be markedly influenced by the manure applied to the plant, by M J Rowlands and B Wilkinson (*ibid* vol 24 p 199 1930) Two similar plots of grass and clover were manured with an artificial manure and pigs' dung respectively the pigs were fed on barley meal, middlings, and a small amount of a mixture of meat meal rye and wheat embryo bone meal, and cod liver oil The manured patch produced a heavier crop, containing more clover, but the growth on the dunged patch was bigger By preventive and curative growth tests on rats it was shown that the vitamin B content of the seeds from the manured patch was much less than that of those from the dunged patch In further experiments vitamin B was extracted from pigs' dung by means of alcohol

There is evidence that lower organisms can synthesise vitamin B or similar growth factors, and that this synthesis may occur also in the intestinal tract in higher animals Thus, Reader has found that the meningococcus can synthesise a growth factor for a streptothrix, all the vitamin B_1 being previously removed from the medium, and G L Peskett (*ibid*, vol 21, p 1102, 1927) has shown that yeast can synthesise vitamin B_1 Intra-

intestinal synthesis may be the explanation of 'refection' which has been described by L S Fridericia and H Chick and M H Roscoe (see *Lancet*, vol. 1, p 37, 1928) In this condition rats maintained on a vitamin B free diet containing uncooked rice starch passed bulky white fæces, and at the same time were cured of their symptoms and put on weight The fæces contained abundant vitamin The condition appeared to depend on the presence of uncooked starch in the diet and a virus in the intestine

W R Aykroyd and M H Roscoe (*Biochem Jour*, vol 23, p 483, 1929) have investigated the distribution of vitamin B_2 Wheat and maize were poor sources the germ and bran of wheat contained more than the endosperm, but maize germ contained less than wheat germ dried peas also contained little Dried yeast and ox liver and fresh milk were excellent sources, and egg-yolk and dried meat good It was possible to cure rats suffering from the dermatitis of vitamin B_2 deficiency, as well as to stimulate their growth

The physiological functions of the vitamin B complex are incompletely understood in its absence the metabolic processes of the tissues are imperfectly performed, and investigations have thrown some light upon the details of the defects Thus the vitamin is related to both protein and carbohydrate metabolism G A Hartwell has found that young rats die, with engorgement of the kidneys, when the synthetic diet contains 20 per cent edestin and 5 per cent yeast extract, although older animals thrived on the diet even with a lower allowance of yeast (*Biochem Jour*, vol 22, p 1212, 1928) Increasing the amount of yeast extract permitted normal growth the factor responsible was found to be thermostable Caseinogen and egg-albumin required less yeast extract than edestin for normal metabolism

H W Kinnersley and R A Peters have investigated the relation between the lactic acid content of the brain and the symptoms of head retraction in pigeons fed on a diet of polished rice (*ibid*, vol 23, p 1126, 1929 vol 24, p 711, 1930) Using a special technique, it could be demonstrated that birds showing opisthotonos had more lactic acid in their brains than normal birds, and that this increase was most marked in the parts below the mid brain and occurred here first at a time when symptoms were threatening The increase was not observed after cure by a dose of vitamin B_1 concentrate The symptoms appear to be due to this accumulation of lactic acid, and the fact that it is localised indicates that vitamin B_1 is intimately concerned in the intermediary metabolism of carbohydrates, apparently with the oxidative removal of lactic acid In this connexion it might be remarked that H Yaoi found that muscle from polyneuritic pigeons reduced methylene blue more feebly than normal muscle, but that there was no difference in the glutathione contents (*Proc Imp Acad Tokyo*, vol 4, p 233, 1928) Peters in his Harben Lectures has adduced some evidence that vitamin B_2 may be concerned with the mobilisation of water, and that in its absence together with that of vitamin B_1 œdema accompanies the polyneuritis in its terminal stages

C W Carter and A N Drury have examined the nature of the slowing of the heart beat in rice-fed pigeons (*Jour Physiol*, vol 68, *Proc*, p i, 1929): it appears to be due to an overaction of the vagal centres producing a heart block The condition is cured by whole wheat, so that the factor responsible may be that described by Williams and Waterman

G F Marrian, L C Baker, J C Drummond, and H Woollard (*Biochem Jour*, vol 21, p 1336, 1927) noticed changes in the adrenal glands of pigeons starved or fed on rice only, and Marrian has investigated these alterations in more detail (*ibid*, vol 22, p 836, 1928) Hypertrophy was found in inanition, even though vitamin B_1 was given, and in vitamin B deficiency, whether accompanied or not by inanition œdema accounted for half the hypertrophy in inanition The adrenaline content was increased in the latter condition, but was relatively low in vitamin B deficiency It appeared that the hypertrophy in inanition affected chiefly the medulla, and in vitamin B deficiency, the cortex of the gland

It is now well known that vitamin B deficiency is associated with loss of appetite B Sure has made a detailed study of the anorexia in the rat and found that it is promptly cured by the administration of a vitamin B concentrate (*Jour Nutrition*, vol 1, p 49, 1928) The loss of appetite may be associated with the failure of the gut to empty itself, and a decrease in the digestive secretions J L Rosedale and C J Oliveiro (*Biochem Jour*, vol 22, p 1362, 1928) found that in pigeons suffering from beri beri the pancreas failed to form the enzymes required to digest protein and fat

It might be expected that animals suffering from vitamin B deficiency would show derangements of the sexual function H M Evans, however, found that in male rats, provided vitamin E was supplied, fertility was unaffected and sex interest was decreased only a few days before death (*Jour Nutrition*, vol 1, p 1, 1928) In the female rat the œstrous cycle stopped abruptly after about four weeks on the deficient diet, loss of weight followed immediately (A S Parkes, *Quart Jour Exp Physiol*, vol 18, p 397, 1928) Injections of œstrin produced the signs of œstrus during the anœstrus, but without stimulating the ovaries, which had become much atrophied

W Nakahara and E Sanekawa have found that chicken sarcoma and rat sarcoma and carcinoma do not apparently require vitamin B_1, and contain little of it (*Proc Imp Acad Tokyo*, vol 5, p 55, 1929 vol 6, p 116, 1930 *Scient Pap Instit Physic and Chem Res*, vol 10, p 211, 1929) In the first set of experiments, chickens were fed on polished rice and a salt mixture, the livers from healthy birds, and those carrying growths of the Rous sarcoma, were found to contain equal amounts of vitamin B by test on rats, indicating that the tumour did not deplete the birds' store of vitamin In the second set, the rat tumours were fed to pigeons and rats maintained on vitamin B free diets only minimal amounts of the vitamin were found to be present

Obituary.

MR H W MONCKTON

MR HORACE WOOLLASTON MONCKTON, who died on Jan 14, was the son of Col the Hon H M Monckton, a younger son of the fifth Viscount Galway, his mother being a daughter of Sir Thomas Woollaston White, Bart He was born in 1857 and was educated at Wellington College His father built a house there, on land belonging to the College, and here Monckton and his sister continued to live for the rest of his life He also had chambers in the Temple, where he lived when not at Wellington He was called to the Bar in early life and had some practice on the Midland Circuit and at the Parliamentary Bar, and was all his life an enthusiastic member of the Inner Temple Visits to the Yorkshire coast and the gault exposures at Folkestone attracted him to geology when still a boy, and in 1882 he was elected a fellow of the Geological Society and he joined the Geologists' Association in the same year Later he became interested in botany, and was elected a fellow of the Linnean Society in 1892

Monckton's residence at Wellington College naturally gave him an interest in the Tertiary and Gravel Beds of the surrounding districts He was associated with the late Sir W H Herries in the discovery in 1880 of an abundant fauna in the Upper Bagshot Beds, when the railway cutting through the Fox Hills at Tunnel Hill was quite fresh The Upper Bagshot of the London basin had hitherto been supposed to be practically unfossiliferous A series of papers followed dealing with the relative ages and positions of the various exposures of Bagshot Beds, both in relation to the London clay and to the corresponding beds in the Hampshire basin In this discussion the Rev A Irving, Sir Henry Lyons, and others took part The Upper Bagshot of the London basin was practically proved, by its fossil contents, to be the equivalent of the Lower Barton series of Hampshire, in a joint paper published in the *Quarterly Journal* of the Geological Society in 1888 by Mr Starkie Gardner, Monckton, and the late Henry Keeping Monckton also wrote many papers on the various gravel beds, extending his researches to Essex and throughout the south-east of England He acted as joint-editor with Mr R S Herries of the jubilee volume of the Geologists' Association, and contributed the articles on the Dorset coast and (jointly with Mr Osborne White) on Hampshire and the Bagshot district He was an indefatigable leader of excursions of the Geologists' Association and various field clubs Monckton's activities were not confined to England He went annually to Norway for a number of years, and studied especially the glacial phenomena there He organised an excursion of the Geologists' Association to that country, and devoted one of his presidential addresses to the Association to the district round Bergen

Though so long officially connected with the Linnean Society, he did not publish much of botanical interest He made considerable collections of plants, however, and was specially interested in mosses In the few contributions he made on this subject, his idea was to link up botany and geology by making lists of plants growing on particular geological soils

No account of Monckton would be adequate which did not mention the great amount of work that he did in the management of the societies to which he belonged He was vice-president and treasurer of the Linnean Society from 1905 until the time of his death He was at one time treasurer, and several times vice-president, of the Geological Society, and served on its Council for some twenty-five years in all Of the Geologists' Association, he was at various times president, secretary for excursions, and editor of *Proceedings* He also on several occasions acted as recorder of Section C (Geology) of the British Association Sound business instinct combined with legal knowledge made his opinion much sought after, and his advice was generally followed by his colleagues

Besides geology and botany, Monckton was interested in archæology and was an excellent photographer, He made his own slides, and was always ready to give a lantern lecture to the Wellington College boys or others He wrote the volume on Berkshire for the Cambridge County Geographies, and the article on geology in the Victoria County History He was also a fellow of the Royal Numismatic Society and made a carefully selected collection of English silver coins He was a man who will be much missed by many friends, and especially by the sister whom he leaves to mourn his loss

PROF A LEITCH

THE death on Jan 26 of Prof Archibald Leitch, director of the Research Institute of the Cancer Hospital, following in less than a year the loss of Dr H J B Fry of the same laboratory (see NATURE, May 31, 1930), leaves a woeful lacuna in the ranks of cancer research Born in 1878, Leitch was educated at Rothesay Academy and the University of Glasgow, where he had a distinguished record in arts and medicine, graduating in 1902 He soon devoted himself to pathology, acting as assistant in the Cancer Research Laboratory of the Middlesex Hospital From London he passed to Dundee as director of the Caird Research Laboratory, a post he occupied until his return to London as pathologist to the Cancer Hospital, becoming director of the Research Institute a few years before the War During the War, Leitch was in charge of a Mobile Laboratory, retiring with the rank of Major, R A M C (T F)

Leitch's most productive period fell in the succeeding years, when renewed interest in carcinogenetic studies followed the pioneer investigations of Fibiger, for whom his admiration was intense, and Yamagiwa His best-known contributions to knowledge in this domain dealt with the carcinogenic action of lubricating oils and the causation of mule-spinners' cancer, and he served on the

Home Office Committee appointed to inquire into this disease

Of greater theoretical importance was Leitch's demonstration of the carcinogenic action of arsenious acid, and the fact that this factor was not responsible for the carcinogenic action of tar He also showed that in the production of tar cancer in mice, the essential damage was completed before the appearance of proliferative changes in the skin, although a relatively long latent period might elapse before definite tumour development supervened This important observation has revolutionised our earlier attitude to the problems of compensation in occupational cancer

Leitch's numerous publications are characterised by a careful and polished diction, enlivened from time to time by striking and appropriate phrases, which betrayed his literary and classical learning and training He was an able and attractive speaker, and many of his addresses on formal and informal occasions were enlivened by a wealth of appropriate anecdote He leaves a widow and four children, to whom will be extended the sympathy of his co-workers at home and abroad

J A Murray

Mr R G Lunnon

Robert G Lunnon, who died on Jan 25 at the age of forty years, was widely known both for his scientific and for his humanitarian work He was educated at Tottenham County School and University College, London, where he held the Neil Arnott Scholarship of the University of London, and after graduating was appointed to a lectureship in the department of applied mathematics During the War he served in France with the Red Cross and later was engaged in relief work for refugees in Holland

In 1919, Mr Lunnon was appointed lecturer in physics at Armstrong College, Newcastle, where he remained to the time of his death His work there gave full scope to his many abilities In addition to his departmental duties, which he discharged with conspicuous success, he undertook a great deal of work on behalf of the students, and had acted since 1926 as senior tutor in the Faculty of Science His colleagues were also greatly indebted to him for his work in connexion with the Association of University Teachers, both as secretary and representative on the council He attended the meetings of the British Association regularly, and served on the committee of Section A

Mr Lunnon's published papers relate to a variety of topics, the best known being a series on the motion of spheres in fluid media, which gave evidence of mathematical and experimental ability of a high order Although extremely active in academic and scientific work, he yet found time for a great deal of social service in various forms These are too numerous to detail, but the cause of international goodwill was perhaps the one nearest his heart, and he laboured to promote it with all the enthusiasm and energy that was in him His students, his colleagues, and his many friends will always remember him with gratitude as one who had great gifts and used them to the full—but always on behalf of others

We regret to announce the following deaths

Sir Andrew Balfour, K C M G, director of the London School of Hygiene and Tropical Medicine, on Jan 30, aged fifty seven years

Dr W E Johnson, Sidgwick lecturer in moral philosophy in the University of Cambridge, and author of a work on "Logic", three volumes of which out of the four contemplated have been published, on Jan 14, aged seventy two years

Prof Orazio Marucchi, professor of archæology at the University of Rome and director of the Vatican Egyptian Museum, on Jan 21, aged seventy seven years

Dr R B Moore, formerly chief chemist of the U S Bureau of Mines and recently professor of chemistry in Purdue University, who was known for his work on radioactivity, applied chemistry and metallurgy, aged sixty years

Dr J Perrin Smith, emeritus professor of palæontology at Stanford University, with which he had been connected since 1892, on Jan 1, aged sixty six years

News and Views.

The causes of the present agricultural depression in Great Britain are reviewed by Mr C S Orwin, director of the Institute for Research in Agricultural Economics at Oxford, in an article in the *Political Quarterly*, vol 2, No 1, entitled "The Agricultural Problem" Although the assertion that in previous years wages have been based entirely on the price of wheat is probably an over-statement, it is evident that at the present time wages are fixed with reference to a standard of living regardless of the condition of the industry, and the fact that the necessity for paying a statutory wage continues, while the guarantee for prices has been withdrawn, constitutes one of the farmer's chief complaints From a comparison of the costs of production of such commodities as wheat, mutton, and milk for the years 1914, 1925, and 1930, it appears that for the two earlier years the corresponding figures were almost identical, and even in 1930 the cost of production has only risen appreciably in the case of wheat The problem is, therefore, mainly one for the arable farmer, but the obvious course of abandoning corn growing in favour of the more profitable industries is no solution for the eastern districts, where climatic conditions are unsuitable for dairying or market gardening, and further, the transformation of these areas into sheep farms could only be done at a great sacrifice of employment and production

The solution of the present agricultural problem, Mr Orwin thinks, lies in a readjustment of the principles underlying arable farming In the first place he questions the advisability of continuing mixed farming, which includes the production of both corn

and meat Times have changed since man was entirely dependent on farmyard manure for the growth of his crops The labour involved in its production and the cost of internal farm transport he regards as unnecessary, whereas an interdependent system of live stock and corn farming might prove quite economical In another aspect also, a break with tradition is recommended Farm and fields were originally laid out in sizes convenient for horse labour, but with the development of the tractor and other forms of mechanical power, some readjustment of areas is needed for efficient working The argument that such an industrialisation of agriculture will only aggravate the unemployment problem is ruled out, as much poor grass land could be profitably used for corn growing if only the cost of production could be reduced A warning is added of the danger of over production if farmers rely solely on those branches of the industry which tend to be profitable at the moment, and emphasis is laid on the necessity for fundamental reorganisation if the solution of the present problem is to be permanent

The trustees of the London Museum have made a new departure in museum work by instituting a studentship for the encouragement of research in some subject germane to the interests of the museum They have been enabled to take this step through the generosity of Viscount Esher, who has placed at the disposal of the trustees the sum of £300 per annum as a memorial to his father, the late Lord Esher, one of the founders of the museum The studentship will be awarded "for the purpose of promoting research into some aspect of the history or archæology of London, whether by documentary research, by excavation, by museum work, or by a combination of these methods" The award will be made by the trustees on the recommendation of an advisory committee, on which representatives of the Society of Antiquaries, the British Academy, and the universities of Oxford, Cambridge, and London will serve, and the tenure will be normally for a period of two years The researches of the student will be incorporated in a thesis, which may, in due course, be published at the direction of the trustees It is hoped that, in the course of years, a very substantial amount of useful and original material bearing directly or indirectly upon the arts, crafts, and history of the metropolis will be collected The scheme may be regarded as an interesting experiment in the development of that extra mural work which is now regarded as appropriate to our national museums Entries for this studentship are invited on or before Mar 14

Towards the end of last month several earthquakes were recorded at Kew Observatory On Jan 27, at 8 h 20 m 59 s P M, the first vibrations of a great earthquake reached Kew, from a centre in about lat 26° N, long 98° E, or near the south west border of China Of this earthquake no direct news has yet come or is likely to come A few hours later, at 5 h 59 m 37 s A M on Jan 28, there was another, though of much less importance, with an origin about 1260 miles from Kew no doubt the same as that reported in the *Times* for Jan 29 as having caused much damage and some loss of life at Koritza in Albania, one of the most active earthquake centres in that country At 9 h 43 m 6 s P M on the same day an earthquake of moderate intensity was recorded with its epicentre in about lat 7° N, long 142° E, or in the western Pacific to the north of New Guinea. The U S Coast and Geodetic Survey (according to a *Daily Science News Bulletin* issued by Science Service, Washington, D C), with the aid of fourteen seismograms, has estimated the position of the Mexican earthquake of Jan 14 to be in lat 16° N, long 96° W, or close to the coast of the Gulf of Tehuantepec, and also to the origin of another destructive earthquake on Mar 22, 1928 An earthquake of great intensity occurred in North Island, New Zealand, on Feb 3 The first shock was noted at 8 51 A M, and shocks continued for two hours The epicentre appears to have been submarine and in the vicinity of Napier, which has a population of 19,000, and the main portion of the city has collapsed A heavy death roll is estimated in Napier and for many miles around A sea wave followed the earthquake

In his presidential address to the Royal Microscopical Society delivered on Jan 21, Prof R Ruggles Gates reviewed certain aspects of the history of the Society showing its importance in the development of biology, and cited some of the eminent scientific men who had taken part in its work Prof Gates then discussed adaptations in cell structure He cited various cases of complicated structures in the Protozoa, and referred to the widespread occurrence of cilia in many animal and plant cells The mechanism of mitosis or nuclear division was treated as an adaptive mechanism which originated very early in evolution and made possible the multicellular structure of higher organisms, at the same time serving to perpetuate many of the differences arising through variation The capillitium in Mycetozoa and puff balls, the elators of Liverworts and of *Equisetum*, were discussed as examples of evolutionary adaptation, arriving at the same goal by different paths The development of the spiral markings in wood cells was explained, and the long, coiled suspensors of Conifer embryos were treated as a study in adaptation and over specialisation through competition between the young embryos and the principle of developmental selection The frequency of parallel mutations in the evolutionary development of many cell structures was emphasised, and it was shown that the principles of adaptation in cell structures are the same as in the development of adaptations in the organism as a whole

For his lecture on the beginnings of tropical medicine, before the London School of Hygiene and Tropical Medicine on Feb 3, Dr P Manson Bahr chose the life and work of Patrick Manson as the chief topic Patrick Manson, to whom the London School of Hygiene and Tropical Medicine owes its inception and its very existence, was one of the most original and outstanding medical personalities of the last century Not only did he himself make many original and lasting discoveries in the field of medicine, but also he

laid the foundations of the science of tropical medicine. Born on Oct. 3, 1844, he graduated at the University of Aberdeen in 1865, and then proceeded to Formosa and worked there as well as in Amoy, China, for ten years before seriously interesting himself in the scientific side of medicine It was in 1875 that he first saw the microscopic embryo filaria in the blood of the local Chinese, and it was in the elucidation of the life history of this parasite that he first achieved everlasting fame He was the first to recognise that this small worm was to be found in countless numbers in the blood at night time, and recognised that its peculiar habits and structure were adapted to a second life in the body of a mosquito This insect he proved to be an essential intermediary in its transference from one human being to another and in its growth into an adult worm, which was afterwards found to inhabit the lymphatic tissue and to attain the length of nearly two inches In 1892 he commenced to study malaria seriously, and deduced the probable life history of this parasite from what he had already ascertained to be the case in the filaria In 1894 he formulated his mosquito-malaria hypothesis and became associated with Ronald Ross It was the outcome of this ideal collaboration which resulted in the verification of the complete cycle of the malaria parasite in the Anopheles mosquito in 1898 In 1897 Manson became medical adviser to the Colonial Office, and became intimately associated with Joseph Chamberlain in schemes for the betterment of health conditions in the Colonies The first outcome of this collaboration was the foundation of the London School of Tropical Medicine in 1899

DR G A REISNER, director of the joint expedition of the Boston Fine Arts Museum and Harvard University in Egypt, has recently given an account at Cairo of his excavations in Giza Cemetery and the Pyramid area, and summarised the evidence bearing on the development of Egyptian ideas on the life after death and the cult of the dead in the Old Kingdom A report of two lectures, delivered on Jan 16 and 20, is given by the Cairo correspondent of the *Times* in the issue of Jan 31 The Egyptian tomb consisted of two parts, the burial chamber and the offering place, the former being originally a square pit excavated in the gravel, which developed finally into a stone mastaba or pyramid The construction of the pyramids in the great cemetery of Giza, founded by Cheops, the second king of the fourth dynasty, employed tens of thousands of men on unproductive labour, and by the end of that dynasty the population was supporting a large body of priests to feed the dead of centuries The funerary priest was a civil functionary who, as a result of contact with an individual, became the servant of his *ka* By a contract, the functionary and his heirs in perpetuity became owners of land, in return for maintenance of offerings in the funerary chapel of the dead The pyramid cities housing these functionaries, who enjoyed immunity from taxation and forced labour, were crowded with inhabitants In tracing the development of other features of the cult—the slab stelæ, the wall paintings, the festivals of the dead, and so forth—Dr Reisner sketched a remarkable picture of the Cemetery of Giza as a city of living spirits whose daily needs were supplied by the living servants they had engaged while themselves still living

THE Electricity Commissioners held an exhaustive public inquiry on the application of the Fulham Borough Council for permission to extend its Townmead Road generating station Judging by the rapid and increasing demand for electric power in the south-east England area, there could be no question about the usefulness of this station , but there was considerable opposition on the ground that it would seriously affect the amenities of the neighbourhood It was suggested that the required power could be obtained by building a new power station on the lower reaches of the Thames If this were done, a transmission system at least 18 5 miles long would have to be provided Numerous high tension cables would therefore need to be provided, and a survey showed that it would be very difficult, if not impossible, to find room for these cables, owing to the existing congestion under the streets The alternative method of laying cables along the bed of the Thames was not considered practicable The loss in transmission due to heating the cables would be about £150,000 a year, and there would in addition be very heavy capital charges To make extensions by building a number of small stations would about double the cost The Commissioners came to the conclusion that any nuisance arising from the emission of grit and sulphurous fumes could be obviated by the installation of modern devices By observing also the conditions laid down by the Port of London Authority, the effluent from this plant can be rendered harmless Assuming that the Fulham Borough Council take the best known precautions for the due consumption of smoke and for preventing so far as reasonably practicable the evolution of oxides of sulphur, the Commissioners gave their consent to the proposed extensions on Jan 27

IT seems highly probable that in a few years' time much of our electric lighting will be done by incandescent gases in luminous tubes and not by incandescent filaments This kind of lighting is generally referred to as neon lighting, but argon, helium, krypton, and other gases are used Although Lord Rayleigh and Sir William Ramsay were the first to separate these gases from the atmosphere, yet the commercial development of them for lighting purposes is mainly due to Georges Claude in France There are now about a hundred companies in various parts of the world exploiting his patents and all bound together by an agreement to interchange technical information and research results. All the countries concerned have a common interest in advancing the science of tubular lighting In the December *Journal* of the Junior Institution of Engineers an abstract is given of a lecture by H Marryat describing many of the recent advances that have been made In the Paris factory the great difficulties in the way of introducing a minute quantity of an absolutely pure gas into an

absolutely clean tube were finally overcome by the introduction into the factory of the methods of the precise scientific worker Neon tubes are familiar in London from being used for advertisement lighting The original voltage used was 32,000, but it has now been reduced to 1000, and tubes have been made in the laboratory that will work at 200 At present their most important use is for the lighting of aerodromes and air routes The light from Croydon beacon can be seen by airmen when flying over France Luminous signals are employed to indicate to the pilot the velocity of the wind and its direction at ground level, so that he may alight against the wind at the correct speed For domestic lighting, however, we have to await the commercial development of the white tubular light, which laboratory experiments have shown to be a very desirable one

In the *Westinghouse International Journal* for January there is an interesting account of a device for controlling traffic which is being adopted in several towns in the United States and is a modification of the 'Stop and Go' light system In many main streets the traffic is always heavier than on a little-used intersecting street, hence the traffic may be held up in the main street although there are no vehicles using the side street In order to obviate this drawback, a device is used in connexion with the 'Stop and Go' light whereby the latter only shines red down the main street when a motor vehicle approaches the intersection from the side street The device is based on the principle of the photo electric cell, and is mounted on a pedestal three feet above the curbstone in the side street, near the crossing When a vehicle approaches from the side street it necessarily has to stop, and in this position it intercepts a beam of light which falls on a device called the 'electric eye' The interruption of this light beam automatically changes the visible signal facing the side street from red to green and the signal in the main street from green to red for an interval long enough to enable the motorist to cross the main street This device enables the traffic speed to be greatly increased, and is working well in everyday use

Dr J Robinson, formerly chief of the Radio Research Department of the Royal Air Force, has invented a system of multiplex telegraphy A demonstration of it was given on Jan 20, at the offices of the *Daily Mirror*, using a line to Bristol and back, a distance of about 240 miles The line was specially lent by the Postmaster-General for the development of the method, and both sending and receiving instruments were in the same room The main advantage claimed for the method is that by its use more than twice as many messages as are now possible can be sent simultaneously over one wire In England only six channel frequencies are employed, but in America twelve are sometimes used The stenode radiostat system uses a separate audible frequency for each of the messages sent The transmission is carried out by modulating each audible frequency at a speed which is determined by the speed of sending It is claimed that with this type of receiver the broad spacing of the frequencies made necessary in practice to avoid overlapping has been considerably reduced. The selectivity of the instrument is due to the successful use of tuning-forks as electrical filters At the demonstration, the channel frequencies were placed apart by only a hundred cycles a second At this spacing, communication of 80 words a minute was carried out

Dr F S Sinnatt, deputy director of fuel research, in a public lecture delivered on Feb 2 at the Sir John Cass Technical Institute, E C 3, gave an account of the work being carried out by the Coal Survey, which is one item in the programme of work of the Fuel Research Division of the Department of Scientific and Industrial Research The Survey is undertaking a systematic investigation of the coal seams of Great Britain, and in order to carry out the work committees have been appointed in all the major coalfields of the country and laboratories have been established at convenient centres The work is now in progress in Scotland, Northumberland and Durham, West Yorkshire, South Yorkshire, North Staffordshire, Nottinghamshire and Derbyshire, and South Wales, while a laboratory is being equipped to serve the coalfields of Warwickshire, Cannock Chase, and South Staffordshire Upon the technical side the investigations are carried out by obtaining a solid pillar of coal representing the whole thickness of the seam, and transporting this to the laboratory, where it may be investigated in detail Certain parts of the analyses are carried out rapidly so as to prevent changes due to oxidation, etc, and the seam is then examined for its physical characteristics and, if necessary, divided into a number of layers, depending upon the character of the seam Samples of the various coals are obtained and submitted in the first instance to proximate analysis, together with the estimation of sulphur and the determination of the calorific value The broad properties of the seam are then reviewed, and after consultation with the staff of the colliery the number of layers which will be examined in greater detail is decided upon The seam as a whole and the various layers are then examined exhaustively It is the object of the survey to trace the variations of the seams throughout the coalfield, and to correlate with this change in properties the possible effect they will have upon the way in which the seam is utilised commercially

Sir J. J Thomson will receive the Dalton Medal of the Manchester Literary and Philosophical Society when he delivers the Dalton Lecture before the Society on Mar 17, 1931

The Second Pedler Lecture of the Chemical Society, entitled "Studies on Biological Oxidation", will be delivered by Prof. H Wieland, of Munich, on Friday, Mar 6, at 5 30 P M, in the meeting hall of the Institution of Mechanical Engineers. Admission is free, without ticket

The second course of Scott Lectures at the University of Cambridge will be delivered by Dr. Irving Langmuir, of the Research Laboratories of the General

Electric Company, Schenectady, N.Y., in the Cavendish Laboratory, at 4.45 P.M., on Feb. 9, 11, 13, 16, and 18. The subject for this course is "Fundamental Phenomena in Electrical Discharges in Gases." The lectures are open without fee to all members of the University.

THE University of St. Andrews has sent its congratulations to Dr. W. W. Keen, of Philadelphia, one of its honorary graduates, on his attainment, on Jan. 19, of the age of ninety-four years. It is twenty-three years since Dr. Keen resigned the professorship of surgery at Jefferson Medical College. The honorary degree of LL.D. was conferred upon him by the University of St. Andrews in 1911, during the celebration of the five-hundredth anniversary of the foundation of the University. Dr. Keen's longevity and cheerful hardihood are matched by those of emeritus Prof. W. C. M'Intosh, also of St. Andrews, who is ninety-two years of age and is still busy with scientific work.

THE following committee has been set up jointly by the First Commissioner of Works and the President of the Board of Education, to consider the recommendation of the recent Royal Commission on National Museums and Galleries that a national folk museum should be established, if possible, in London, and also to advise as to the practicability and cost of establishing such a museum: Sir Lionel Earle (chairman), Mr. E. R. D. Maclagan, Mr. E. S. Makower, Sir Henry Miers, Prof. J. L. Myres, Mr. C. R. Peers, Sir Henry Richards, and Dr. R. E. Mortimer Wheeler. The secretary is Mr. E. F. Muir, Ancient Monuments Branch, Office of Works, London, S.W.1.

AT the annual general meeting of the Royal Microscopical Society, held on Jan. 21 at B.M.A. House, Tavistock Square, W.C.1, the following officers and new members of council were elected: *President*—Prof. R. Ruggles Gates; *Treasurer*—Mr. Cyril F. Hill; *Secretaries*—Mr. J. E. Barnard, Dr. Clarence Tierney; *New Members of Council*—Mr. C. Beck, Mr. G. R. Bullock-Webster, Prof. R. T. Hewlett; *Librarian*—Dr. Clarence Tierney; *Curator of Instruments*—Mr. W. E. Watson Baker; *Curator of Slides*—Mr. E. J. Sheppard.

THE provisional figures of the vital statistics for England and Wales for 1930 have been issued by the General Register Office. The rates per 1000 population were: for births, 16.3, the same as for 1929, which was the lowest recorded; and for deaths, 11.5. The death rate is 1.9 below that for 1929, and is the lowest recorded, being 0.1 below the rates for 1923 and 1926, the previous lowest. The infant mortality rate (deaths under one year per 1000 live births) was 60, and was also the lowest on record, being 5 per 1000 below that for 1928, the previous lowest, and 14 per 1000 below that for 1929.

MESSRS. Flatters and Garnett, Ltd., of Manchester, have issued a new catalogue of lantern slides illustrative of the various branches of science. There is a very wide range of types amongst this collection, from plain and coloured photographs of geological interest to macroscopic pictures of plants and microscopic photographs and diagrams of Protophyta and Protozoa. The list in all branches, and especially that of botany, has been greatly enlarged. This is due chiefly to Mr. Flatters, who is especially interested in the study of plants from the anatomical and histological point of view. Messrs. Flatters and Garnett, Ltd., take full advantage of the fact that their establishment is close to the University of Manchester. Members attend the public lectures, meetings, and exhibitions which are held in the University, and their assistants are sent to the evening course in biology. Thus much valuable information with regard to the production of lantern slides, the type required, the arrangement of lists, and so forth, is obtained. The lantern slides produced by Messrs. Flatters and Garnett, Ltd., are invaluable assets to the public lecturer, the university lecturer, and the school teacher.

MESSRS. W. Heffer and Sons, Ltd., Cambridge, will publish shortly "The Scientific Detective and the Expert Witness", by Dr. C. Ainsworth Mitchell, which work aims at giving a more or less popular description of the methods by which those with specialised training have been able to assist in solving problems constantly arising in criminal investigation.

THE Museum of Comparative Zoology at Harvard University announces that the first volume of a check list of the birds of the world by James Lee Peters is now in press and will be issued shortly. The classification followed for the higher groups is that proposed by Dr. Wetmore, with the sequence of genera and species according to the author's own ideas where no authoritative treatment has been published. The first volume will contain about three hundred genera and one thousand seven hundred species and subspecies. It is expected that at least ten volumes will be required to complete the work. The second volume is in active preparation and preliminary work on others is under way. The new check list is not a Museum publication and will not be distributed to the Museum's exchange list, but will be sold by the Harvard University Press.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A professor of anatomy in the Madras Medical College and a professor of anatomy and physiology in Vizagapatam Medical College—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Feb. 10). A principal of the Acton Technical College—The Secretary (F), 10 Great George Street, Westminster, S.W.1 (Feb. 14). A museum assistant in the Leicester Museum and Art Gallery—The Director, Museum and Art Gallery, Leicester (Feb. 16). Inspectors under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Acts, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Feb. 16). A temporary assistant mycologist under the Department of Agriculture for Scotland, for work in connexion with bracken disease—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Feb. 16). A principal of

the Kingston upon-Thames Technical College—The Secretary, Education Department, County Hall, Kingston upon Thames (Feb 21) Inspectors under the Board of Education, for technical and evening schools—The Secretary, Board of Education, Whitehall, S W 1 (Feb 21) A senior lecturer in physics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W C 2 (Feb 24) A University reader in mathematics at Westfield College—The Academic Registrar, University of London, South Kensington, S W 7 (Feb 27) A lecturer in physics at Armstrong College — The Registrar, Armstrong College, Newcastle-upon-Tyne (Mar 5) Assistant examiners in the Patent Office — The Secretary, Civil Service Commission, Burlington Gardens, S W 1 (June 4) A temporary science master at Merchant Taylors' School, for chemistry (or possibly physics) during May, June, and July—The Headmaster, Merchant Taylors' School, Charterhouse Square, E C 1 A Grade "E" technical assistant in the Signals Experimental Establishment — The Superintendent, Signals Experimental Establishment, Woolwich Common, S E 18 An advisory veterinary officer at Reading University, for the Southern Province—The Registrar, The University, Reading.

Our Astronomical Column

Registration of Solar Prominences—In a recent issue (No 88) of the *Bulletin* of the Kodaikanal Observatory—a biannual publication containing current observations of solar prominences and disc phenomena recorded spectroscopically at Kodaikanal—the Director, Dr T Royds, directs attention to the publication of additional data of prominences photographed in hydrogen light (Hα) There are two spectroheliographs in daily use at this observatory, one of which is used for obtaining composite photographs showing the disc markings and the prominences at the sun's limbs in calcium light (K), whilst the other instrument is employed for registering the disc markings in hydrogen (Hα) light Owing to the increased speed of panchromatic plates, it has been found possible to include in the daily programme since Jan 1, 1929, the registration of the prominences in hydrogen light Dr Royds finds that the mean daily areas of Hα prominences in 1929 are considerably less, about 54 per cent, than those of the calcium prominences This, he points out, is not necessarily to be interpreted as evidence that the hydrogen prominences are less extensive or less high than calcium prominences, for there are numerous examples where individual prominences are identical in shape, height, and area in the Hα and the K photographs There is, however, considerable evidence that in the fainter and more scattered parts of K prominences the Hα counterpart is relatively much fainter when compared with the brighter parts of the prominence This is not a photographic effect caused by the under exposure of the Hα plate, for whilst the main part of a prominence may be stronger in the Hα photograph than in the calcium, the reverse is often true in the fainter parts of the same prominence The exact relations between the relative intensities in different parts of Hα and K prominences require further study, and it is very satisfactory that data for this purpose will be accumulated at Kodaikanal

Rotation Period of Uranus—The two most trustworthy determinations of this period were those made by Profs Lowell and Slipher at Flagstaff in 1911 and that of Mr L Campbell in 1917, the former was spectroscopic, the latter by light variation The results were practically identical, $10^h\ 50^m$ and $10^h\ 49^m$ respectively But there was considered to be room for a further investigation, since the indicated probable error of the spectroscopic method was 17 minutes, and the light variation was not confirmed by several other observers It may, however, have been produced by a temporary marking *Pub Ast Soc Pac* for December contains an account of a new spectroscopic determination made by Messrs Moore and Menzel They used a higher dispersion than Lowell and Slipher, also the equator of Uranus is more nearly central on the disc Their weighted mean is $10^h\ 50^m$ with a probable error of 10^m, but in spite of the close accord with the previous results, they do not consider that the period is certainly known within several minutes, Mr Moore's results, taken alone, give $11^h\ 18^m$ and those of Mr Menzel $10^h\ 26^m$ The uncertainty arises from the small size of the disc of Uranus It will be remembered that in their Neptune investigation they estimated the uncertainty as a full hour

The *Gaz Astron* for January announces that M V Tshernov has been making photometric observations of Uranus during the autumn of 1930 He finds for the period of rotation $10^h\ 47^m\ 34^s$ Before opposition the range of magnitude was from 5 97 to 6 16, after opposition, from 5 78 to 6 10

The Radial Velocities of the Spiral Nebulæ—Prof. C D Perrine notes in *Astr Nach*, No 5754, that radial velocities of recession approaching 10,000 km/sec have been deduced at Mount Wilson for some of the faint distant spirals He makes the suggestion that the annual aberration of these objects should be compared with that of neighbouring stars, according to former ideas, since these bodies are receding with a velocity one thirtieth of that of light, the velocity of their light-waves relatively to the observer would be less than that of the stars in the same proportion Hence the constant of aberration for them should be greater than for the stars by 0 7″, a quantity easily measurable on good photographs

According to Einstein's theory the apparent velocity of the light is constant for all objects But just as observations of the Einstein shift of stars near the sun are still made during total eclipses, it would seem to be worth while to make this experiment in order to test the theory further Photographs should be taken as nearly as possible at the times when the objects are at the two ends of the major axis of the aberration ellipse

Minor Planets—*Kleine Planeten* for 1931 (published by the Berlin Rechen Institut) indicates that there are now 1152 numbered planets, five of those discovered in 1930 having been already numbered. Many planets that were long missing have been picked up, and there are now only five planets in the first 400 that have been lost since the year of their discovery Many new names have been given, the seventh Trojan planet, discovered in 1929, has been named Odysseus The names Probitas, Perseverantia, and Hilaritas have been given to three planets discovered by the late Dr Palisa of Vienna, being regarded as expressing qualities of his character A group of planets are named after flowers Begonia, Camellia, Petunia, Primula Planet 1134 is named Kepler

Research Items.

A Hand-Axe from East Anglia.—Mr. J. Reid Moir, in *Man* for January, figures and describes a hand-axe found last November in the Upper Chalky Boulder Clay at Ipswich. It was dug out of solid clay at a depth of 2½ ft. It was in two pieces, which lay about 15 in. apart. The fracture was ancient and had been caused by thermal action along the line of a weakness in the flint, without doubt at the time of the deposition of the boulder clay. The specimen is typical of the implements found in the Upper Chalky Boulder Clay. In colour it is greyish-black, and shows no sign of patination or abrasion. There are a few ancient striations. The flaking is all of one period. Greatest length $4\frac{3}{16}$ in., greatest breadth $2\frac{13}{16}$ in., greatest thickness $1\frac{1}{16}$ in., and weight approximately 8½ oz. There is now a large body of evidence to show that the Upper Chalky Boulder Clay of East Anglia, representing the third glacial period of this part of the country, was laid down at the close of the Early Mousterian epoch. The flint implements found in the boulder clay have all been derived from other and older deposits torn up by the glacier in its advance. In certain parts of East Anglia sites have been discovered where these deposits have escaped destruction and they have been shown to contain artefacts such as occur in the boulder clay which overlies them. These pre-Upper Chalky Boulder Clay deposits are usually in the form of brick earth such as have been excavated and studied at Ipswich, Hoxne, and High Lodge. In each of these cases the Upper Chalky Boulder Clay overlies the brick earth and in the latter deposit at Hoxne and High Lodge have been found hand-axes of precisely the same type and workmanship as that now described. One found by Mr. Reid Moir at Hoxne in an Early Mousterian floor at the base of the brick earth under the glacial bed laid down by the Upper Chalky Boulder Clay glaciation is almost a duplicate of this specimen. It may now be said that the Early Mousterian period in East Anglia was succeeded by the third glaciation in that area and that *in situ* in the Upper Chalky Boulder Clay which was then laid down derived flint implements of the Early Mousterian epoch have been unearthed.

Treatment of Trypanosomiasis.—Dr. Louise Pearce has written a critical review entitled 'The Treatment of Human Trypanosomiasis with Tryparsamide' (Monograph No. 23 of the Rockefeller Institute for Medical Research). Tryparsamide is the name given to the sodium salt of *N*-phenylglycineamide-*p*-arsonic acid, a compound developed at the Rockefeller Institute for Medical Research during the course of chemotherapeutic investigations on certain protozoan infections. It has the advantage of being very soluble in water and may be administered intravenously, intramuscularly, or subcutaneously with satisfactory effects. The dose is usually 2 gm., and the amount required for the treatment varies from 15 gm. to 25 gm. for early cases up to perhaps 100 gm. for advanced cases. The only untoward effect noticed has been visual disturbances in some 5 per cent of the cases, which is more or less permanent in 1·8 per cent of the cases. The present analysis deals with the results obtained in 1197 cases of sleeping sickness with *Trypanosoma gambiense* infections, of which 96 were considered to be early cases and 1101 late ones. Of the early cases, some 96 per cent appear to have been cured by the drug. Of the 1101 advanced cases, 646 (58·7 per cent) appear to be cured, 272 (24·7 per cent) were improved, and 183 (16·6 per cent) were failures. The results obtained with tryparsamide appear to be vastly superior to those observed with any other drug. Several other papers which have appeared since this analysis was written are also reviewed, and a bibliography is appended.

Fresh-water Mussels Raised in the Laboratory.—The *Daily Science News Bulletin*, Science Service, Washington, D.C., of Nov. 21 announces that Dr. M. M. Ellis has discovered a method of speeding up the development of fresh-water mussels. In its natural environment the mussel spends the first four to six weeks of its life as a parasite on a fish. Dr. Ellis has found a nutrient medium to take the place of the fish in which the mussel is able to develop. After spending a certain time in the medium, the mussels important economically for the making of pearl buttons may be planted out in the rivers which have been depleted by pollution. The raising of these molluscs will be undertaken at the University of Missouri in the new laboratory space just provided by the University for the use of the U.S. Bureau of Fisheries.

Biology of the River Wharfe.—F. Percival and H. Whitehead have already done good work in connexion with Yorkshire streams and rivers. Their recent paper, "Biological Survey of the River Wharfe. Introduction and Report on the Invertebrate Fauna" (*Journal of Ecology*, vol. 18, No. 2, Aug. 1930), records investigations arising out of meetings of the research committee of the Yorkshire Naturalists' Union, in which the River Wharfe, being practically unpolluted, was decided on as a subject requiring detailed examination. Three stations representing the three main physiographic regions through which the river flows, were worked monthly over a period of one and a half years, and in addition subsidiary collections and observations were made at other stations. A net with a mesh of 0·5 mm. was chiefly used, allowing a number of small creatures to escape. Therefore some groups such as the Protozoa, Nematoda and Rotifera have been omitted. Insects are the most important and are dealt with fully. The station at Ulleskelf, where the river becomes affected by tides, is markedly different from the others. The great majority of the species from all the stations require water well charged with oxygen. The environmental conditions and dominant invertebrates are given for each station, and notes on the different groups show details of distribution, habitat, and breeding seasons. There seems to be little seasonal variation in the faunas except those related to breeding and life-cycles. Most of the insects produce eggs from March to October. General conclusions of a preliminary nature are that the various types of stream bed can be approximately classified according to their structure and fauna, and that the variation in number of organisms is due in part, at any rate, to the nature of the life-cycle, to the effect of temperature, and to the amount of rainfall both during the previous breeding season and at other times, and the amount of flooding, of erosion, and general disturbance of the river bed.

Genetics of Field Mice.—Dr. F. B. Sumner has contributed a further account of his well-known investigations on the geographical sub-species of the field mouse, *Peromyscus* (*Jour. Genetics*, vol. 23, No. 2). It is unfortunate that these important researches, which he has carried on at the present Oceanographical Laboratory in Southern California for more than fifteen years, are now to be discontinued, for they represent the most extensive study yet made of the natural sub-species in any mammal. We have

received from Dr. Summer a request to point out two errata which occur on p. 307 of the present paper. In line ten, "$(4/5)'$" should read "$(4/5)^3$", and in the nineteenth line, "$(5/6)^2$" should read "$(5/6^4)$". The present paper contains a mass of data, statistically treated, resulting from crosses between the three sub-species, *leucocephalus*, *albifrons*, and *polionotus*, and also from a fortunate cross between two species of *Peromyscus*. The results are too numerous to summarise here, but the paper is a searching inquiry into the conception of multiple genetic factors as applied to sub-specific crosses. Differences in depth and extent of pigmentation, the tail stripe, and other features are believed each to depend upon several multiple factors, but it is concluded that the formulæ of Castle and Wright for determining the number of such factors is not applicable. The tables of measurements of tail, foot, ear, etc., in the hybrids have also been analysed. Wide phenotypic variability and other conditions offer great difficulties, and it cannot be said that the multiple factor hypothesis as here applied is a great success, in spite of the great care and attention to detail which has entered into the analysis. The author is inclined to favour the view that the genetic changes between sub-species have resulted in some direct way from the action of the environment, the colour mutations being selectively controlled by their value in concealment.

Mitogenetic Rays.—A monograph upon this subject was reviewed in NATURE of July 13, 1929. It will be remembered that Gurvitsch and his school suggest that a special type of short wave length radiation promotes cell division; they thought to detect this radiation by pointing one growing root tip at another at close range, when the number of cell divisions in the second root was said to be greater, as the result of 'irradiation' from the tip of the first root, on the side 'exposed' to the pointing tip. Around this conception a lively controversy has raged, and so long as the only tests applicable to mitogenetic radiation are the number of cells in a tissue in a state of division, or the number of buds produced in a growing yeast culture, conclusive critical evidence in support of the new radiation remains difficult to produce. Of considerable importance therefore is a paper by Stempell (*Biol. Zentralblatt*, **49**, Heft 10; 1929) in which he attributes to the radiant energy from such growing organs the power of destroying the Liesegang rings which are formed with beautiful regularity when a drop of silver salt is placed on the centre of a thin layer of gelatin containing ammonium bichromate. These experiments of Stempell have been repeated and confirmed by B. P. Tokin (*Biol. Zentralblatt*, **50**, Heft 11; 1930), but at the same time this worker makes it clear that this interesting result is due to the volatile substances, probably ethereal oils, which are given off from the crushed tissue of the onion, which has been the source of the 'mitogenetic' radiation in these experiments. Tokin's work seems to make it quite clear that this new experimental field has failed to produce any evidence for the existence of 'mitogenetic rays'.

Mica-Peridotites of India.—In his memoir on "The Jharia Coal Field" (*Geol. Surv. India*, vol. 56; 1930) C. S. Fox gives a valuable account of the remarkable peridotite intrusions associated with the faults and coal seams of the region. The coalfields of the Damuda valley represent a series of areas of Gondwana sediments set in a pavement of Archæan gneisses on which they lie and into which they have been faulted. The synclinal structures of the so-called basins result from tectonic movements. The peridotites are generally much altered. Many are characterised by an abundance of mica, but the most remarkable feature is the richness in apatite, as first disclosed by Sir Thomas Holland in 1894. The high phosphorus content in the coals of many of the Gondwana fields can be traced with tolerable certainty to the peridotite intrusions. A number of new analyses are presented and attention is directed to these because of their petrological and geochemical significance and because they might easily be overlooked in a memoir dealing mainly with coal. The peridotite magma appears to have been squeezed up through fault planes in the gneissic floor, but once it entered sedimentary rocks the bedding planes offered numerous channels for escape, mainly above or below coal seams, where the bedding planes appear to have been more easily separable than elsewhere in the series.

Comparative Study of Soil Profiles.—An exceptionally thorough investigation of soil profiles in Holland and Java has been made by A. Te Wechel, L. Möser, and C. Van Aggelen (*Mitt. Geol. Inst. Landbouwhoogeschool in Wageningen, Holland*, No. 16, 1930). The profile on Senonian limestone in Holland is compared with the profiles on loess in Holland and on Tertiary limestone in Java. The end products of soil formation are closely similar from the two contrasted types of parent rock in Holland, whereas they are widely different from the two similar rocks studied in Holland and Java (see table). The importance of climatic control is thus clearly demonstrated. The microscopic (petrological), physical, and chemical character of the parent rocks and of four or five horizons in the profiles of each of the three examples investigated have been very fully determined. The memoir is well illustrated and constitutes one of the most illuminating studies of weathering and soil genesis yet issued.

Constituents	Holland		Java
	Loess Soil	Limestone Soils	
$CaCO_3$	2.21	1.75	2.02
SiO_2	73.55	73.38	37.87
Al_2O_3	8.04	7.59	24.08
Fe_2O_3	2.89	2.63	8.95
Clay	41.40	40.50	37.80
Humus	5.14	4.42	4.31

The Constant of Gravitation.—A redetermination of the constant of gravitation (G), by P. R. Heyl, is described in the December number of the *Bureau of Standards Journal of Research*. The apparatus used was much the same as in the dynamical method of Braun, with, however, a considerable increase in the magnitude of the large attracting masses, and with the incorporation of the refinements possible to any one working in a large institution. The attracting masses on the moving system were small spheres of gold, platinum, and optical glass, in each case of about 50 gm., but with the large stationary masses a radical change in shape was made, cylinders being substituted for the spherical form which had been previously almost universally employed; the mass of each was about 66 kgm. The reduction of the experimental data is thus enormously complicated, but it has been found that series which remained manageable could still be calculated fairly readily to express the forces due to the cylindrical masses; full details of these, which are probably of value in other connexions, are given. Other points in the experimental arrangements are the use of tungsten filament wires for the suspensions in place of quartz, with very satisfactory results, and the magnetic shielding

of the small paramagnetic and diamagnetic spheres which was found to be called for The value finally adopted for the constant is $6\ 670 \times 10^{-8}$ cm^{3} gm^{-1} sec^{-2}, with a precision of 0 005, as measured by the average departure from the mean This result is in very good agreement with Boys' and Braun's value of $6\ 66 \pm 0\ 01$, in the same units There is a curious outstanding discrepancy in the apparent dependence of the value on the material of the small masses, but it is considered that this is not due to the nature of the material

Properties of Molecular Hydrogen—In a paper in the January issue of the *Proceedings of the Royal Society*, on the chemical constant of hydrogen vapour and the entropy of crystalline hydrogen, T E Stern has extended some earlier calculations made by R H Fowler, essentially by introduction of the Einstein Bose statistics in place of classical statistics His results are important chiefly from the fact that they increase somewhat the accuracy of results predicted by Mr Fowler, excellent agreement being obtained with Eucken's empirical values for the chemical constant In addition, however, Mr Stern has made some interesting remarks upon the nature of molecular motion in crystals His analysis, like that of Mr Fowler, assumes that the molecules of hydrogen rotate in the crystalline solid much as they do in the gas, and, as he points out, the reasonable nature of the predicted results furnishes good evidence for the validity of the assumption It is not certain, all the same, that the moment of inertia remains unaffected by passage to the condensed phase, and an experiment is suggested by means of which any such change could be detected There is possibly already evidence for a small diminution of the moment of inertia in formation of the liquid when liquid hydrogen is formed from the vapour from Prof McLennan's investigation of the Raman effect Rotation of molecules in crystals would appear not to be a universal phenomenon, as Mr Stern refers to a theoretical investigation by Pauling as showing that in some crystals molecules cannot rotate at all, whilst in others they move in an irregular fashion which corresponds to wave functions intermediate between those for pure rotation and for pure oscillation

Constitution of Coal—Two of the methods for studying the constitution of coal are the use of solvents for fractional extraction and the examination of the products of oxidation At a meeting of the Royal Society of Arts on Nov 26, Prof W A Bone summarised the results of his experience with these two methods (*Jour Roy Soc Arts*, **79**, 77) By means of benzene under pressure, material can be extracted from coals which is divisible into four fractions Prof Bone has adduced from this evidence that the solid fraction is really the material which imparts to a coal the property of forming a coke By controlled oxidation of the extracted residue he has not only confirmed the view that the main product is a mixture of benzene carboxylic acids, but also accounted quantitatively for the material of the reaction The same sort of product was obtained from coal in all stages of formation and in the carbonisation products, indicating that the benzenoid structure is present throughout He advanced the view that coal is of the nature of a 'bakelite'

Energy Distribution in an Oil Circuit-Breaker—One of the most difficult problems which electrical engineers have to solve is to devise switches capable of breaking circuits in which large currents at high voltages are circulating If the switch is incorrectly designed, the limit of rupturing capacity is low, and if used for large currents a short circuit results and the switch is destroyed Automatic oil switches are now in general use, as they have been found both efficient and trustworthy An arc drawn out between the separating contacts underneath the oil is rapidly cooled and compressed by the surrounding oil The special feature of the switch seems to depend on the squeezing effect of the oil on the arc In a paper read to the Institution of Electrical Engineers on Jan 8 by C E R Bruce, an elaborate study is made of the distribution of energy in an oil circuit breaker The paper is the latest of the reports on the subject made by the British Electrical and Allied Industries Research Association It deals in considerable detail with the energy dissipated by large oil circuit breakers at a pressure of 5500 volts Rough but satisfactory measurements have been made of the various ways in which the energy liberated is dissipated The energy dissipated at the contact surfaces and radiated from the arc was measured experimentally That required to heat, vaporise, and break up the oil was calculated The rest of the energy used for raising the arc to the gas temperature and in dissociating the hydrogen present could then be found and the temperature of the arc calculated The temperature found in this way was about 3500° K (3227° C) This value is nearly double the value (1750° C) which has previously been used Tests were made with both open and closed tanks and with copper and aluminium electrodes Interesting theoretical calculations are also given

Electric Incubators—In his recent address to the Scottish Centre of the Institution of Electrical Engineers, E Seddon gave an example of how electrical power is enabling the struggling industry of poultry farming to compete with imported products It is a good illustration of the gradual mechanisation of farming The Buttercup Dairy Co has an electrical poultry farm near Edinburgh stocked with 200,000 laying hens There have been installed nine incubators, each capable of holding 16,000 eggs The eggs are placed end downwards in special trays and packed tightly to prevent movement The trays are then placed in the incubators at an angle of 45° The eggs require to be turned during the process of incubation, by an ingenious device the trays are turned about a horizontal axis until they are perpendicular to their former position The motion is reversed every six hours Each incubator has an electric heater taking 2400 watts, which maintains the temperature between the limits of 99 5° and 100 F The heat is controlled thermostatically and if the temperature varies by so much as 1° a bell rings On the eighteenth day the trays of eggs are tested by being placed over high candle power lamps The unfertile eggs are quickly removed and the trays placed in the hatching compartments The chicks hatch regularly on the twenty first day The average number of infertile eggs is 21 per cent, and 9 per cent contain dead germs The chicks pass from the incubator rooms in cardboard boxes to the brooding rooms The essential requirements are a constant supply of fresh air, protection from draughts, uniform temperature, and a moist atmosphere Air drawn in by electric fans is steam warmed and then drawn upwards through the cages containing the chicks to the exhaust fan in the roof A complete change of air is effected every five minutes All windows are of blue glass and the electric lamps are tinted blue It is found that the chickens thrive under these conditions Special lighting is arranged in the laying sheds to ensure egg laying in the winter months Electrically driven conveyors convey the food to the bins, the consumption being about 150 tons of meal per week

Cleveland Meeting of the American Association for the Advancement of Science.

THE American Association for the Advancement of Science and its affiliated societies held their annual meeting at Cleveland, Ohio, during the week of Monday, Dec 29, 1930, to Saturday, Jan 3, 1931 The attendance shown by the registration records was 2635 The sessions were held in the lecture rooms of Western Reserve University and the Case School of Applied Science, the large gymnasium of the University was used as a registration hall and for the exhibits

The meeting was held under the presidency of Dr Thomas Hunt Morgan, of the California Institute of Technology The retiring president, Dr Robert Andrews Millikan, of the same institution delivered the principal address on Monday evening, on atomic disintegration and synthesis, this address appears in NATURE of Jan 31, p 167

At its meeting on Thursday, the Council, the governing body of the Association elected as president for 1931 Prof Frans Boaz, of Columbia University, long a leading figure in American anthropology The resignation of Prof Burton E Livingston, of the Johns Hopkins University, who has been permanent secretary of the Association for the past ten years, was accepted and Prof Charles F Roos, of Cornell University, was elected to fill the vacancy Prof Roos had been secretary of Section K (Social and Economic Sciences) since 1928 Prof Livingston was elected general secretary in succession to Prof Frank R Lillie of the University of Chicago

Sectional vice presidents for 1931 were elected as follows A (Mathematics), Dr Earl R Hedrick, University of California at Los Angeles, B (Physics), Prof Bergen Davis Columbia University, C (Chemistry), Dr Charles A Browne, U S Bureau of Standards, D (Astronomy), Dr J H Moore Lick Observatory, E (Geology and Geography), Prof Douglas Johnson, Columbia University, F (Zoology), Prof R W Hegner, the Johns Hopkins University, G (Botany), Prof Elmer D Merrill, New York Botanical Garden H (Anthropology), Prof W K Gregory, American Museum of Natural History, I (Psychology) Prof H S Langfeld, Princeton University, K (Social and Economic Sciences), Prof G C Evans, Rice Institute, L (Historical and Philological Sciences), Prof W B Munro, California Institute of Technology, M (Engineering) Prof Dexter S Kimball Cornell University, N (Medical Sciences), Prof H T Karsner, Western Reserve University, O (Agriculture), Dr C W Williams, Ohio State Agricultural Experiment Station, Q (Education), Prof Ernest Horn, University of Iowa

Plans were made for future meetings of the Association The present year will see the inauguration of the new plan for holding a meeting during the summer months, in addition to the winter meeting The first of the summer meetings will be held in Pasadena, California, in June The 1931 winter meeting will be held in New Orleans, Louisiana The summer meeting for 1932 will be held in New Haven, Connecticut, and the winter meeting probably in Atlantic City, New Jersey The summer meeting for 1933 will be held in Chicago The 1932 winter meeting should have been planned for Chicago, according to the policy of holding quadrennial meetings of the Association in Chicago, Washington, and New York in rotation, but the plan was modified to permit the Association to meet in Chicago while the forthcoming World's Fair there is in progress

The Association's prize of one thousand dollars for an outstanding paper presented at its winter meeting, given each year by an anonymous benefactor, was awarded for a paper entitled "Experiments with High voltage Tubes", presented by Dr M A Tuve, Dr L R Hafstad, and Odd Dahl, of the Carnegie Institution of Washington, Department of Terrestrial Magnetism Using a Tesla coil with a tuned spark in the primary, they have built up voltages of five million and above They have also constructed vacuum tubes of pyrex upon which a voltage of two million can be impressed without rupturing them Operating these tubes at a working voltage of 1 4 millions, they have obtained beta particles with a velocity within 1 per cent of the speed of light, and gamma rays of a corresponding intensity Since it is possible to achieve theoretically unlimited voltages by building up a large enough series of Faraday cages, sufficiently well insulated, Dr Tuve and his associates intend to carry their researches with high velocity discharges just as far as the limits of available materials will let them

Another paper of outstanding interest and of great potential practical significance, though it was not entered for the consideration of the prize committee, was that of Dr W W Swingle, of Princeton University, and J J Pfiffner, of Coldspring Harbor, N Y, on "The Hormone of the Suprarenal Cortex" The authors have used a cortical extract successfully in reviving animals prostrate and apparently at the point of death from adrenalectomy It has also been employed successfully in the clinical treatment of Addison's disease, hitherto regarded as incurable A number of other papers were presented on endocrine physiology, especially on the effects of various hormones on the physiology of reproduction

Dr Harlow Shapley, director of the Harvard College Observatory, announced that the compilation of the latest results of the sky mapping campaign of his observatory indicates an irregular distribution of galaxies in space The Harvard College Observatory now has photographs of about one tenth of the sky, showing all objects within the limits of photographic visibility These show hitherto unknown galaxies to the number of about eighteen thousand This irregular distribution of galactic matter in space, Dr Shapley said, favours the concept of a non static universe put forth by Le Maitre, Tolman, and others, as against the Einsteinian idea of a static universe, which demands a uniform distribution of galaxies

The planet Pluto, the discovery of which in 1930 was the outstanding astronomical event of more than a generation, was sought and found but left unrecognised eleven years ago Dr Seth B Nicholson, of the Mt Wilson Observatory, California, made this known for the first time in a paper read before the Section of Astronomy In 1919 workers at this observatory conducted a search in the region where the trans Neptunian planet had been predicted by Lowell The image of the planet appears on a number of their plates, but at the time it went unnoticed among the host of low magnitude star images After the discovery of Pluto by Clyde Tombaugh at the Lowell Observatory, Arizona, the old plates were checked over and the planet images found

A suggestion as to the possible mode of formation of petroleum in the earth was offered by Dr S C Lind, director of the School of Chemistry of the University of Minnesota Dr Lind and his associates have succeeded in synthesising carbon compounds of a complexity approaching that of the constituents of petroleum by subjecting simple compounds like methane to pressure, high temperature, alpha particle bombardment, and electrical discharges He suggested that pressures and energy discharges developed in the process of crustal movements, acting

on simpler hydrocarbons, might readily have built up the larger molecules of petroleum He would not at the present time, however, undertake to say whence came the simpler hydrocarbons, the raw materials in this geokinetic manufactory

A lipoid extract from tuberculosis bacilli was reported to act as a true antigen against the organisms that produced it, by Prof R J Anderson, of Yale University Prof Anderson has also discovered a new fatty acid in the bacillus, which seems to be the active agent in the formation of the tubercles that are the name-symptom of the disease The new compound has been named phtiotic acid

A modification of the now classic Chamberlain Moulton hypothesis of planetary formation was put forward by Prof Kirtley Mather, of Harvard University Prof Mather accepts the idea that the nucleus of a planet is provided by the tidal extrusion of a ' bolt ' of stellar stuff, caused by the near approach of two stars He believes that this initial bolt contains the larger part of the mass of the new planet, possibly nine tenths of it, including nearly all of the heavy metals, especially iron and nickel Planetesimal accretions account for only the outer tenth of the total final spheroid

Of the numerous symposia, perhaps the most popularly attractive was that on the future of man, conducted by the American Society of Naturalists on the afternoon of New Year's Day This was participated in by Dr A V Kidder, of the Carnegie Institution of Washington, who presented the subject from the archæologist's point of view, Prof William F Ogburn, of the University of Chicago, who considered it from the sociological angle, and Prof E M East, of Harvard University, who spoke as a geneticist Prof Kidder opened the discussion in the rôle of a Cassandra, giving warning that if we are to build on the analogies furnished by past cultures, our own civilisation is in for a terrific crash unless by concerted action we head it off But beneath the shadow of this Spenglerian doom, the succeeding two speakers indulged in a fine bout of Wellsian prophecy They envisioned a world population of about three and one half hundreds of millions of people, speaking one general language, composed of blendings of all the races, though nationalisms, and probably wars, will continue Africa and the two Americas will be predominantly white, the native races will be largely extinguished, and their remnants absorbed into the dominating population The Malayan peoples will about hold their own, but will not increase their territorial holdings, the Mongolian race will expand greatly Birth control knowledge will be universal, parenthood, restricted by social pressure and indirect rather than direct legislation, will be honoured, and babies at a premium The stream of scientific discovery and invention will continue in ever increasing tempo, changing the social order faster than the social order can adjust itself to the changes, thereby keeping social sanctions and moral codes in a constant state of flux With oil all gone, coal supplies dwindling, and such natural sources as water and wind power insufficient, the world will be hard put to it for sources of power, for the ' cracking of the atom ' is a vain dream Many factories will go to the land for both raw stuffs and labour, instead of sending to the land for materials to be worked up in town Thus the entire population will be urbanised

Among the scientific exhibits, the one that attracted most attention was that of Dr George W Crile, a surgeon of Cleveland, who with his associates has re combined lipoid, protein, and mineral salt fractions of animal tissue, obtaining microscopic bits of colloid stuff which he calls ' autosynthetic cells ' Although they are not alive, they display many of the physicochemical phenomena of living cells, such as an electrical gradient from the centre outwards, absorption of food material (protein), increase in size, division into new units, absorption of oxygen and elimination of carbon dioxide, and deterioration and ' death ' in the presence of toxins

Of more immediate practical importance is the new X ray technique employed by Dr Thomas O Menees, of the Blodgett Memorial Hospital, Grand Rapids, Michigan, to learn the sex of a fœtus so much as three months before birth The method consists in the injection into the fœtal circulation of a small quantity of strontium iodide This is non toxic, and opaque to X rays, thus permitting the photography of fleshy parts as well as bone The effect fades after three hours and entirely disappears in a day It is expected that the new technique will be of value in doubtful cases where a Cæsarian section seems to be indicated

The United States Bureau of Standards exhibited specimens of rubber vulcanised by a new method, employing trinitrobenzene instead of sulphur This rubber has the virtue of being non corrosive to metals that cannot stand contact with sulphur vulcanised rubber, making possible such things as rubber plated steel and copper Another exhibit of the Bureau of Standards was a set of ' fourth dimensional ' models constructed by Dr Paul R Heyl These bear the same relation to figures in the fourth dimension that the two dimensional pictures in books and on blackboards bear to figures in three dimensions

Dr Dmitry Borodin, who is working at the Boyce Thompson Institute, Yonkers N Y, presented a demonstration of his method for measuring the effects of mitogenetic radiation He cultivates yeast in hanging drop colonies, and measures with the planimeter the comparative areas of colonies exposed to the radiations and of control colonies

Though not shown in the exhibits, a new type of phonograph was mentioned in one of the discussions of the physics section This uses, instead of records, motion picture film with twelve sound tracks on it The machine can use a five hundred foot film, and can play a two and one half hour grand opera at one ' loading ', The quality of the sound reproduction is said to compare favourably with high grade radio reception from a near by station Commercial production of the new film phonograph, however, is not planned for the near future FRANK THONE

Botany in South Africa

ON Nov 10, Dr Arthur W Hill, who has since had the honour of K C M G conferred upon him, landed in Cape Town, on the invitation of the Government of the Union of South Africa, for the purpose of making personal contact with botanical affairs in the country After spending some ten days in Cape Town, Sir Arthur Hill proceeded by the "Garden Route" to the forests of George and Knysna, proceeding from there to Port Elizabeth, Grahamstown, and East London, and then travelling to Bloemfontein and Fauresmith At the latter place Sir Arthur saw the work which is being carried out at the recently established Karroo Pasture Station He described this station as the most remarkable which he had seen in the course of his travels throughout the world. Here the semi-desert shrubs which form the vegetation covering the great Karroo areas were being investigated as regards their palatability, carrying capacity,

and food value From Fauresmith Sir Arthur Hill proceeded eastwards over the Drakensberg Range via Van Reenen's Pass and Ladysmith to Pietermaritzburg, from which place he travelled to Durban From Durban he went to Pretoria and, after spending ten days there, travelled north to the Woodbush Mountains and thus completed his tour in the Union

Before Sir Arthur left Pretoria, the Union Government gave a reception in his honour at the botanical laboratories attached to the Division of Plant Industry At this reception Col G N Williams, Secretary for Agriculture, welcomed him on behalf of the Union Government In doing so, he spoke of the long and close association which Kew had had with the South African Departments of Agriculture, and also mentioned the many botanical expeditions with which Sir Arthur had been connected in different parts of the world

Mr C E Legat Chief Conservator of Forests, welcomed Sir Arthur on behalf of the Forest Department He mentioned the assistance which the Department of Forests had received from Kew, and stressed the fact that South Africa had to depend upon the introduction of exotic trees because the native timbers took between 150 and 200 years to mature

Dr I B Pole Evans Chief of the Division of Plant Industry and Director of the Botanical Survey of South Africa, welcomed Sir Arthur on behalf of the botanists of South Africa He described the great benefits which Kew had rendered to South Africa, and referred to the publication of the "Flora Capensis" and the assistance which the South African Governments had given in the matter He referred to the close association between the Botanical Survey of South Africa and Kew, whereby the Survey had maintained at Kew for some years past a South African botanist to assist with critical determinations, etc Dr Pole Evans mentioned the botanical areas, institutions and problems which Sir Arthur had seen, and expressed the hope that he would realise that botanical science had made considerable strides in the country during the past twenty five years, and that South Africa must in the future endeavour to help herself much more than she had in the past

Sir Arthur in returning thanks to the Government for its invitation, referred to the great importance and educational value of botanic gardens He stated that he would like to see three great botanical gardens flourishing in the Union There were the Kirstenbosch Gardens, but in addition he would like to see one in Natal and one in Pretoria He spoke of the excellent work which was being done at Fauresmith and at Pretoria on the pasture plants of the country, and also stressed the importance of the work that was being done by the Botanical Survey Regarding forestry matters, Sir Arthur expressed high appreciation of the work for the preservation of native forests in the Knysna area In concluding, he hoped that means would be found for subsidising post graduate research work in botany, since he thought South Africa would derive considerable benefit from work of this nature

General Smuts moved a vote of thanks to Sir Arthur Hill, the British Government, and the Union Government, and pointed out that Sir Arthur was the first of Kew's great directors to undertake a tour of the Dominions—and in this connexion General Smuts paid a great tribute to the foresight of the Empire Marketing Board in making this possible He referred to the valuable gift which Sir Arthur had made, through Kew, to the National Herbarium at Pretoria by donating type specimens of many of the older collections, and pointed out that the National Herbarium at Pretoria would now be able to do a very large part of the work which Kew originally did He expressed the view that the time would probably come when South Africa might well become one of the great pasture countries of the world, and for this reason, every effort should be made to develop the country's natural resources This might in time become a question for the whole of Africa, and they would see not only one institution, not only one country such as the Union, but all the African Governments collaborating and trying to solve common problems Science would have to be applied more and more to the economic situation General Smuts referred to the great spaces in South Africa and the difficulties which isolated workers had to contend with, and he felt that Sir Arthur's visit would be a great inspiration to those people

After the speeches of welcome, Dr A C Leemann spoke on "Plant Immunity and the Aims of Modern Plant Pathology" He gave his audience the benefit of his researches in his own entirely new line of work in the realm of plant immunity, in which, by reinforcing soil conditions he has found it possible to effect a marked change in the immunity of plants to certain fungus diseases Dr Leemann supplemented his remarks by giving a demonstration of plants which had been inoculated under these conditions

Guests were then given the opportunity of inspecting a very interesting and instructive series of exhibits illustrating the work of the Division of Plant Industry These included amongst others —(1) Photographs of much of the vegetation of those parts of the country which Sir Arthur Hill had not been able to visit (2) A collection of old type specimens presented to the National Herbarium by Kew and Berlin (3) A collection of living pasture grasses recently collected on a tour from Pretoria to Lake Tanganyika (4) A trap specially designed by Mr H Harris, as a result of his work in Zululand, for catching tsetse flies The success already achieved by the use of this trap opens up considerable possibilities with regard to tsetse fly control (NATURE, Nov 22, p 817)

This visit of Sir Arthur Hill to the Union of South Africa is of outstanding significance, and much of botanical interest should accrue from it, for there is probably no part of the British Empire which has contributed more towards the pure and economic branches of botanical science, and it is scarcely possible to encounter a flora which could excel that of South Africa in beauty and scientific interest

Scotland's Testimony to the March of Evolution.

THIS subject formed the main part of Prof James Ritchie's inaugural address (reprinted in part in the *Scottish Naturalist*, Nov Dec 1930) on his induction to the Regius chair of natural history in the University of Aberdeen

Prof Ritchie reminded his audience that bears were once common in the Caledonian forest, and that he, with his collaborators, had found in caves near Inchnadamph, in Sutherland, bones of bears, remains of wolves, lynxes, Arctic foxes, and lemmings, and more than nine hundred antlers of reindeer All these animals, and more besides, have disappeared from Scotland, they have been swamped in the struggle for existence Red deer, once common throughout Scotland, are now restricted to the Highlands, wild cats, pine martens, and polecats are dying out, and the white tailed eagle, the kite, and the osprey have disappeared On the other hand, many species of wild ducks are now nesting where they never bred before, and the fulmar petrel, for centuries confined

to St Kilda and its islands, has in a generation colonised the north coast and the east coast to Flamborough Head. These and other changes in the balance of life illustrate the accommodation of living things to changing conditions and hence successful colonisation, and, on the other hand, the failure to accommodate and consequent elimination

In his second line of evidence, Prof Ritchie referred to examples of the plasticity of living forms "Put broadly, Creationism emphasises the immobility of living forms, Evolution emphasises their plasticity" He pointed out that in a relatively short time Scotland has impressed its mark upon domestic animals among horses it has bred the Clydesdale, among cattle Aberdeen Angus, Ayrshires, Galloways and Kyloes, among dogs Skye terriers and others, among sheep Cheviots and Highland blackfaces—surely sufficient evidence of the plasticity of living forms that evolution demands Granted that this plasticity can be made apparent by man's efforts, what evidence is there that it plays a part in natural processes? Prof Ritchie believes that Scotland demonstrates better than almost any other country the evolution of life in progress The former fauna was entirely obliterated in the ice age, and the new fauna flocked into the country from Europe But all the animals are not exactly as they were, changes have been taking place revealed by the intense examination of modern zoologists The red grouse of Scotland is clearly different from the willow grouse of the Continent, it is a different species Of the one hundred and fifty-nine different species of birds which breed in Scotland, thirty two show characters which distinguish them from their closest relatives on the Continent Others—and thirty one of these are named—are distinct geographical races which, although differing from their continental relatives, are not different enough to be regarded as distinct species Of the fifty six different species and races of mammals which breed in Scotland, thirty are different from the most closely related continental forms, and of these, specialists have regarded eight as distinct species and twenty two as geographical races

Prof Ritchie illustrated his argument by particular reference to the St Kilda house mouse and the St Kilda field mouse, both regarded as distinct species, and remarked that it is reasonable to suppose that these are the direct descendants, slightly modified, of the original migrants from the common fauna of Europe

"In the fauna of St Kilda and in the thirty two distinctive birds and thirty distinctive mammals of Scotland we are looking upon the modelling from old species of new species and of geographical races, which we regard as the incipient stages of new species

"In the changes taking place in the balance of life, in the plasticity of animal form, and in the formation of new races and species not in the distant past of geologists, but in recent times, we are looking in Scotland upon evolution in its course"

The Mechanics of Mountains *

THE earth's upper crust in the continents appears from seismology to consist of three layers, an upper one of granitic constitution, about 10 km thick, an intermediate one about 20 km thick, the properties of which fit tachylyte, and a lower one probably of dunite, extending half way to the centre of the earth Above the granitic layer is the sedimentary layer, with an average thickness of probably about 2 km, but considerably thicker in special regions The outflow or inflow involved in maintaining isostatic compensation is in the lower layer, but at a smaller depth than 50 km

The mechanical properties of the outer crust indicate that the crustal shortening in a major epoch of mountain formation should be of the order of 40 km The actual height and extent of the great ranges correspond to a shortening of about 60 km This estimate is arrived at by considering what elevation would be produced if the light upper layers were compressed by a given fraction of their original length and enough outflow in the dense lower layer took place to restore isostasy

This estimate is much less than the horizontal movement observed in the field, and the only possible explanation is that the horizontal movement is a surface phenomenon almost confined to the sedimentary layer and caused by the crustal shortening, but not equivalent to it

Prolonged deposition of sediments leads to an obstruction of the normal outflow of heat from the earth, and hence to an increase of temperature and a reduction of strength through a depth of the order of 100 km, thereby localising the yield when the stresses due to contraction of the interior become too great for the strength of the outer crust to withstand The immediate result of a local failure would be a local elevation so high that the heated sediments would proceed, as a secondary effect to flow out horizontally under gravity and give a series of flat folds closely resembling the observed nappes Explanations of 'back folding' and of the gneissic core of a great mountain system appear to follow naturally

Emphasis is laid on the importance of recognising the intermediate layer in discussions of the mechanics of geological processes Isostatic readjustment can take place by horizontal outflow in this layer as in the lower layer, though much more slowly, and this process may play an important part in the formation of geosynclines and the levelling of old mountain systems

* Substance of a lecture by Dr H Jeffreys, F R S on The Mechanics of Mountains, at the Geological Society of London, on Dec 31, 1930

Sinkage of Logs

THE sinkage of logs during the river journey to the pulp wood mills is a matter of considerable importance owing to the loss thereby incurred The question has formed the subject of research by Prof G W Scarth, Botanical Department, McGill University, and Mr E C Jahn, associate professor of chemistry, School of Forestry, University of Idaho, the work being assisted by funds contributed by the Canadian Pulp and Paper Association A paper on "Sinkage Studies—I" has now been published (*Can Jour Research*, vol 2, June 1930) Experiments were made with logs of jack pine, spruce, poplar, balsam, and birch

The distribution of water in floating logs (in a lake) was found to be similar to that in living trees It was noted that the sapwood of these species became wet all round whilst the heartwood was relatively dry, becoming wetter in the order of the species given above, the heartwood in birch became as wet as the sapwood The rate of radial penetration of water into logs of these species increased in the order, birch, jack pine, spruce, balsam, poplar, the penetration

taking place very slowly, even into the sapwood Narrow outer rays and density of the wood diminish the rate of penetration The advantage of a large proportion of relatively dry heartwood depends more on the initial buoyancy it confers than on the greater resistance to penetration it may possess In air dry logs penetration of free water is also very slow, saturation of the cell walls precedes it at a greater rate The gas in floating logs is surrounded by water and can only escape in solution There appears to be evidence that more gas may be liberated by fermentation of storage material in the parenchyma cells

The problem as to whether escape of gas or penetration of water is the leading factor in determining the rate of sinkage of cut logs has been studied by Mr R D Gibbs, of the Department of Botany, McGill University and published under the title "Sinkage Studies—II" (*Can Jour Research*, June 1930) The species investigated were balsam, jack pine, birch, and poplar In freshly cut softwoods, possibly excepting balsam, the water content is fairly uniform, very high in the sapwood but low in the heartwood In birch the water content was higher in the centre than near the outside whilst the reverse was the case in poplar In jack pine the heartwood contained about 12 per cent water, the sapwood 52 per cent Generally the heartwood contains more gas than the sapwood, and consequently the greater the proportion of heartwood in a log the better its floating properties In the jack pine the heartwood contains 60 per cent of gas and the outer layers of wood about 23 per cent Wood and density values vary considerably Consequently, even by allowing for the variation of density across a log the errors in measurement are scarcely reduced In order to reduce error, standardised lots of logs should be examined, and seasonal and other measurements should be restricted to these lots

The results of this investigation, when it has been carried further are likely to have a wider application than to Canada alone, and they must therefore be regarded as of high value

University and Educational Intelligence

Cambridge —It has been announced by the vice chancellor that the treasurer has received a cheque for 5000 dollars "as a grant toward Dr Eric K Rideal's new department of colloids" No condition is attached to this gift, except that the donors do not wish their names to be published

Mr G U Yule of St John's College, has been appointed reader in statistics Miss M M O'Reilly, of Girton College has been appointed assistant curator of the Museum of Archæology and Ethnology

The vice chancellor has given notice that the Montague Burton professorship of industrial relations has been established, and that a meeting of the electors will be held on Feb 27 Candidates are requested to communicate with the vice chancellor on or before Feb 14

Sir Walter Thomas Layton has been elected to an honorary fellowship at Gonville and Caius College

Edinburgh —The University Court at its meeting on Monday, Jan 26, received, with much regret, intimation from Prof A Robinson, professor of anatomy, of his intention to retire at the end of the current academical year Dr C H O'Donoghue was appointed director of studies to students taking combined degrees in medicine and science Leave of absence for the summer term of 1931 was granted to Prof G Barger, in order to enable him to deliver a course of lectures in the University of Heidelberg It was announced that the Right Hon Winston Churchill would deliver the Rectorial Address on Thursday, Mar 5 Mr M Davidson was appointed lecturer in the Department of Engineering, to give a course of lectures and laboratory work in the subject of heat engines for second-year students The Court received, with gratification, intimation of the gift to the University Department of Geology, by Mrs Currie, of the valuable collection of minerals formed by the late Dr J Currie

Oxford —On Jan 27 a decree was passed by Congregation authorising a grant towards the expenses of a projected Oxford University Expedition to Baffin Island in the summer of 1931 This expedition will have similar objects to those of the recent expedition to Spitsbergen Another decree authorised the Curators of the University Chest to receive sums not exceeding £500 per annum for the purposes of a scheme of research in economic ornithology, the scheme to be carried out by the Department of Zoology and Comparative Anatomy

Notice is given by the Royal Society that applications for the government grant for scientific investigations must be made on special forms, returnable to the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W 1, by, at the latest, Mar 31

In 1926 a Commission was set up which inquired into and advised on the system of technical education in relation to the requirements of trade and industry in the Irish Free State It stressed the necessity for a sound organisation of continuation schools and classes, the object of which was to link the work of the primary school at age fourteen years with that of the technical school at age sixteen years, when young people normally enter employment The Vocational Education Act imposes upon newly appointed vocational education committees the duty of establishing and maintaining such continuation schools and classes A memorandum has been issued by the Department of Education with the view of assisting the committees in their task ("Vocational Continuation Schools and Classes in the Irish Free State" Messrs Eason and Son, Booksellers, Lower O'Connell Street, Dublin) Since out of approximately 120,000 young persons between fourteen and sixteen in the Free State, 45 000 are in primary and secondary schools, the task of the committees is to provide suitable education for the remaining 75,000 Although the memorandum is confined to the subject of continuation schools and classes, it specifically stresses the fact that it conveys no suggestion of diminished activity in technical education On the contrary, the anticipation is that provision of organised continuation classes will lead to an increased demand for technical education The memorandum is divided into two parts, the first of which recapitulates the relevant sections of the Vocational Education Act with which the committees must deal It indicates that obligatory attendance will not become operative until the necessary order is made careful and complete organisation is, however, the necessary preliminary to the making of that order In developing their schemes the committees are to secure information on the occupations open to young people in their area, the conditions of entry into these occupations, the forms of skill and knowledge helpful to beginners, and the attitude of employers, employees, and parents to vocational education By this means definite and reliable advice will always be available. Suggestions for organisation of rural education, the use of existing technical schools, and the gradual provision of new buildings are given The second part of the memorandum deals with the details of organisation and curricula

Birthdays and Research Centres.

Feb 8, 1868 —Lord ROTHSCHILD, F R S , Trustee of the British Museum

I have studied the morphology and systematics of birds and butterflies and moths for forty five years, and have endeavoured to make a world wide collection of these, as complete as possible, to serve as material for higher studies in structure, evolution, and geographical variation, for which larger series of each species and race are necessary than the usual museums can find space for

I am, at the present moment, much occupied in the study of certain melanic mutants of birds and insects, and it would be of great interest in the investigation of evolution if a careful study could be made of these melanic forms, in order to ascertain why melanic forms are almost invariably dominant, while white or blue forms are recessive Miss Edna M Turner is at present at Cambridge studying the question whether *physiological* and *chemical* differences are inheritable, and as melanic forms are due to an excess of *melanin* in the organism suspected, her line of investigation will be the one to demonstrate incidentally the reason for dominance or the opposite

Feb 11, 1862 —Dr F S MACAULAY, F R S , formerly mathematical master at St Paul s School London

A solution is desired of the following problem — Let f represent any polynomial in n variables, x_1, x_2 x_n with coefficients belonging to a corpus K, and ϕ any polynomial in x_1, x_2, x_r only, with coefficients in K Let M be a module of polynomials with a given basis $(f_1, f_2, \quad f_k)$, that is, let M be the whole aggregate of polynomials $a_1f_1 + a_2f_2 + \quad + a_kf_k$ where $f_1, f_2, \quad, f_k$ are given, and $a_1, a_2, \quad, a_k$ are arbitrary, polynomials of the type f It is required to find (that is, to devise processes for finding) a basis $(f_1 \; f_2, \quad f_k)$ of the module M which is the aggregate of *all* polynomials f such that $\phi' f' - 0(M)$, where f is an f and ϕ' a ϕ (n, r, k are given, but not λ)

A step towards the solution is to find at least one particular ϕ such that $\phi f = 0(M)$ for every $f = 0(M)$ Then M can be more simply described as the aggregate of all polynomials f' such that $\phi f' = 0(M)$, where ϕ is known One value for ϕ is $\phi_1' \phi_2 \quad \phi_k$, where $\phi_i \; f_i - 0(M)$, but this only shows that a ϕ exists satisfying the conditions

Feb 14, 1896 —Prof E A MILNE, F R S , Rouse Ball professor of mathematics in the University of Oxford

My chief investigation now in progress is on the structure of the stars, their interiors and atmospheres

Observational astrophysics is rapidly increasing in scope, accuracy, and richness of method, but theoretical astrophysics scarcely as yet bears the same relation to observational astrophysics that theoretical physics bears to experimental physics Theoretical astrophysics is largely an array of disconnected investigations of special points It needs to acquire classical theorems and a recognised logical development The beginnings of this are indeed to be found in the solutions of the classical problems associated with the names of Schuster, Schwarzschild, and Emden But at present it is as if theoretical physicists were devoting themselves to working out the consequences of each separate experiment instead of synthesising a theory of general principles Rather than investigating the detailed stellar situations disclosed by special observations, the worker in theoretical astrophysics might well devote himself to the more abstract aspects of idealised problems A sharp distinction needs to be drawn between the manufacture of theories about the stars and the investigation of idealised models The former need the touch of inspired imagination The latter can be tackled by all, have a permanent value independent of current theories, and afford a sound background and corrective to speculation Astrophysics might then emerge as a science as exact as geometry

Societies and Academies

LONDON

Mineralogical Society, Jan 13 F C Phillips On a soda margarite from the Postmasburg district, South Africa A fuller description is given of material first described by A L Hall The mineral occurs in mica like crystals associated with the Postmasburg manganese ores The physical properties described resemble in general those of a mica, but analyses show 50 per cent of alumina and 10 per cent of alkalis, with little lime It is best described as soda margarite, in composition it resembles the 'ephesite' of J L Smith —**F A Bannister** On the distinction of analcime from leucite in rocks by X ray methods Powder photographs of phenocrysts in blairmorite from the Lupata Gorge, Zambezi River, Portuguese East Africa, are identical with those for analcime and not for leucite The icositetrahedral outlines of the analcime phenocrysts found in the rock strongly suggest their primary origin The X ray photographs indicate that the phenocrysts are not single crystals, but consist of aggregates of particles in sub parallel position **F A Bannister** On a chemical, optical, and X ray study of nepheline and kaliophilite (with chemical analyses by M H Hey) correlated data have enabled the author to prove the approximate constancy of the number of oxygen atoms in the unit cells of several nepheline and elæolite specimens Thence the numbers of atoms of each kind per unit cell have been counted The cell volumes and optical properties have also been related to the chemical composition An approximate structure is suggested which, together with the chemical work explains the variable composition of nepheline Kaliophilite is shown to possess a much larger cell than that of nepheline, and its Lauegram exhibits higher symmetry Pseudonepheline (rich in potassium) has a slightly greater cell volume than normal nepheline, but its Lauegram is almost identical and its axial ratio the same —**H V Warren** On an occurrence of grunerite at Pierrefitte, Hautes Pyrénées, France A grunerite schist consisting almost entirely of fibrous grunerite, occurs at the Pierrefitte mine where needles of the same mineral also occur in the galena and blende of the ore bodies The grunerite is associated with a carbonaceous schist and with magnetite, and encloses specks of carbon Analyses of grunerite from schist and ore by E G Radley are given

Geological Society, Jan 14 —**E S Cobbold** Additional fossils from the Cambrian rocks of Comley (Shropshire) Species referred with reserve to *Micmacca* Matthew in 1910 are now confidently placed under that genus, or under *Strenuella*, and the relationships between *Protolenus*, *Strenuella*, and *Micmacca* are noted The very plentiful *Ptychoparia attleborensis* Shaler and Foerste is placed under Walcott's genus of the Eodiscidæ, *Pagetia*, on the strength of an enrolled specimen of the complete dorsal shield Some six or eight specimens of *Weymouthia nobilis* Ford throw considerable light on this species A new genus is proposed for an undescribed Lower Cambrian

trilobite, which seems intermediate between *Dorypyge* and *Centropleura*

Linnean Society, Jan 22 —**C G Trapnell** Vegetation in Godthaab Fjord West Greenland The Oxford University Greenland Expedition, 1928, worked principally at Iserssintilik, in Godthaab Fjord, lat 64° 40 N The problem of the classification of this heath is considered with reference to the climatic series of vegetation types found and to competition —**B P Pal** Burmese Charophyta An investigation into the systematics, distribution, ecology, and economic importance of Burmese Charophytes Burma has a large number of species belonging to the genera *Chara* and *Nitella* The importance of Charophyta as destructive agents of Culicid larvæ was negatived by experiments on *C gymnopitys* and two species of *Nitella* An apparent larvicidal effect in one case was discovered to be due to the presence of larvæ eating insects

BRUSSELS

Royal Academy of Belgium, July 5 —**Th De Donder** The invariantive theory of the calculus of variations (9) —**H Buttgenbach** Mineralogical notes Crystals of gold of sphene, and of garnet —**Oct Dony** The reduction of zinc oxide by carbon monoxide in a gas cycle, and on the mechanism of this reduction Carbon monoxide, formed by circulating carbon dioxide over graphite at about 1000° C, rapidly reduces zinc oxide at about 1040° C to metallic zinc The admixture of solid carbon with the zinc oxide is unnecessary —**Victor Willem** The architecture of bees —**L Godeaux** An algebraic variety representing couples of inverse points of space and on surfaces of the fourth order having four uniplanar double points —**Jean Genard** A new resonance series of sulphur vapour —**R H J Germay** The rôle of an exponential in the development in series of solutions of generalised Lagrangian equations The application to the Gauss equation —**G Gilta** The crystalline form of some alkylarsinic acids and alkaline alkylarsinates —**A Heyting** Intuitionist logic —**R Deladrière** Generalisation of the fundamental identities of the Einstein gravific

Aug 2 —**Victor Willem** The respiratory operations in *Xenopus* —**Th De Donder** Invariantive theory of the calculus of variations (10) —**Lucien Godeaux** The groups of three *W* congruences having a common focal surface **E De Wildemann** Aerial roots —**J Melon** Two minerals from the Belgian Congo a non pyroelectric tourmaline with special facies and a colourless chrysoberyl without twinning —**Marcel Winants** New applications of the theory of integral equations **Miron Nicolesco** Functions conjugated on a surface as defined by Beltrami —**R Bouillenne** Contribution to the study of the phenomenon of osmosis in plant cells A new apparatus for the measurement of the velocities of penetration of saline solutions in plant protoplasm —**R Bouillenne** Studies on the permeability of cells of *Tradescantia virginica* and of *Allium Cepa* Applications of the apparatus described in the preceding communication —**R and M Bouillenne** Sexuality and cellular oxidations in *Mercurialis annua* —**M and R Bouillenne** Experimental researches on the toxic agent of the pollen of Ambrosia An investigation into the chemical constitution of pollen poisons A bibliography relating to hay fever is appended —**Constant Lurquin** The functional relations for the mean elements of probability

ROME

Royal National Academy of the Lincei Communications received during the vacation, 1930 —**G Andreoli** Pseudo integrals and pseudo derivatives —**Maria Pastori** Partial derivation of tensors in relation to their intrinsic and partially intrinsic representation —**Vladimiro Bernstein** Ultra-convergence (*Ueberkonvergenz*) of certain Dirichlet series —**Radu Badesco** Singularities of the solutions of a class of integral equations —**M Manarini** Asymptotic lines on a surface Application of Levi Civita's conception of parallelism leads to the establishment of a necessary and sufficient condition for a line traced on a surface to be asymptotic —**M Pierucci** The orbit of the ultra Neptunian planet (2) With the new data for Lowell s planet obtained by Crommelin in July last, the three values for $\sqrt{ab}$ as yet found are 40 40 and 39 12 (Crommelin) and 39 90 (Banachiewicz) The mean of these values, 39 81, differs from the value calculated according to the author's rule by 0 46 per cent, and the mean difference between the calculated and observed equivalent radii is reduced to 4 31 per cent —**L Caldo** Julian reform of the calendar —**G Boaga** Formulæ for the topographic corrections in Eötvössian remainders —**A Belluigi** Physical characteristics of the Modenese Apennine marginal plain —**M Lombardini** The motion of the mass of air in the atmosphere —**C Dei** Determination of the vapour pressure of ice at low temperatures The method of measurement employed is based on the values of the explosive potential in a discharge tube corresponding with different known values of the density of the water vapour filling the tube The results thus obtained for the vapour pressure of ice, in mm of mercury, are at −22 3° 0 58 ± 0 023, at −55°, 0 0166 ± 0 0008, and at −66° 0 0037 ± 0 0002 These values agree satisfactorily with those given by other authors —**B Del Nunzio** A thermal analogue of the Barkhausen effect —**D Graffi** The theory of the propagation of heat by natural convection —**G Bozza** The mode of action of certain gas blowers (2) —**A Nasini and G Natta** The crystalline structure of the inert gases, krypton (2) X ray examination of solid krypton by the powder method in a special chamber reveals a face centred cubic structure The unit cell, which contains four atoms has a side of 5 78 A and the volume 193 × 10 ⁻²⁴ c c the density is 2 83 —**G A Barbieri** Colour reactions of the molybdo octocyanides —**C Sandonnini and S Bezzi** Catalytic decomposition of cetyl alcohol At 340° 350° and in presence of oxides of aluminium zinc, chromium, or iron, cetyl alcohol behaves similarly to primary alcohols with fewer carbon atoms Dehydration of the alcohol by means of alumina furnishes a simple method of preparing hexadecylene in good yield —**G R Levi and D Ghiron** Oxidation and reduction cells of alkali chlorites (2) —**A Ostrogovich and V Galea** γ Triazines Synthesis of two aralkylaminothioltriazines Benzylaminothioltriazine prepared by the method used for obtaining the corresponding alkyl derivatives, melts and decomposes at 270° 271° while styrylaminothioltriazine, obtained by the method used for the aryl compounds, melts and decomposes at 284° 285° —**C Richard** A peculiar asymmetry of *Physeteridae* and its relation to cranial asymmetry —**G Mezzadroli and E Vareton** Action of ultra short electromagnetic waves, λ = 2 3 metres on silkworms The action of an exposure of thirty minutes daily to these waves manifests itself in an acceleration of the life cycle After 20 days of the treatment, commencing when the worms are 15 days old, the increases in weight and length are respectively 112 and 37 per cent The irradiated worms begin spinning some days earlier and give an appreciably greater yield than the untreated controls —**G Brunelli** Colonisation of artificial lakes —**Giulio Cotronei and Celso Guareschi** Zoological constitution and transplanting Experiments on *Anura* and

Urodeles (5).—Aldo Spirito. Experiments on the grafting of more extensive embryonic parts between *Anura* and *Urodeles*.—C Jucci Cocoon colour and blood-pigment migration to the silk in the F_1 of reciprocal crosses between the Chinese gold, native yellow, and Japanese white races of silkworms.—M Mitolo Reflex excitability as a function of pH

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 16, No 10, Oct 15).—Paul S Epstein Reflection of waves in an inhomogeneous absorbing medium A mathematical discussion It is concluded that for an angle of incidence larger or slightly smaller than the angle of total reflection, a non-conducting medium gives total or considerable reflection, a slightly conducting medium behaves similarly With increase of conductivity, reflection decreases rapidly and the coefficient of reflection becomes very small with large conductivity Hence reflection is insignificant except when conductivity is small and the conditions approach total reflection, thus in radiotelegraphy, if rays are reflected, their paths can be computed neglecting conductivity, as if the medium were transparent—G E Coghill The structural basis of the integration of behaviour Observations of the developing salamander indicate that the law or pattern of development consists in the expansion of a total pattern of action within which partial patterns arise by individuation through restriction of the field of motor action and the field of adequate stimulation This has been demonstrated for unconditioned reflexes and seems to apply to the formation of conditioned reflexes and instincts The structural basis of the law appears in the growth of the nervous system.—C Judson Herrick Localisation of function in the nervous system The first neuromuscular reactions in the salamander are executed by localised chains of neurons discharging into the total body musculature Innervation of limbs, etc, is an outgrowth from this integrated system Local reflexes are established, but the neurons in the brain conveying them are linked up in a dense network of fine nerve fibres (the 'neuropil') This diffuse and relatively equipotential neuropil provides the basis for behaviour generally, it is nearly homogeneous, but not quite, since every part receives a preponderance of fibres from specific sensory fields.—Wilder D Bancroft and George Bancroft Glycogen metabolism A reversible equilibrium, maintained by enzymes, between glycogen or glucose and lactic acid, is postulated Apparent displacement of equilibrium is due to changes in adsorption of glycogen by protein—Paul S Epstein Note on the nature of cosmic rays Rossi has suggested that if the cosmic rays are fast electrons, they have an energy a little less than 10^9 volts It is shown mathematically that electrons of 10^9 volts energy coming from outside would be much deflected by the earth's magnetic field and can strike the earth only in two limited zones around its magnetic poles Practically all countries where cosmic rays have been observed are outside these zones.—H T Engstrom Periodicity in sequences defined by linear recurrence relations

Official Publications Received

BRITISH

Proceedings of the Seventeenth Indian Science Congress, Allahabad 1930 (Third Circuit) Pp. xi+539 (Calcutta Asiatic Society of Bengal.) 15 rupees.

Department of Agriculture, Trinidad and Tobago. Vol 1, Part 3 Flora of Trinidad and Tobago Olocales, Celastrales, Sapindales. By R O Williams Pp. 165-196 (Trinidad Government Printing Office.) 1s. 3d

The Medical and Scientific Archives of the Adelaide Hospital No 9 (For the Year 1929). Pp 126. (Adelaide Harrison Weir)

CATALOGUES.

The Nickel Bulletin. Vol 4, No. 1, January Pp. 32. (London The Mond Nickel Co., Ltd)

Arctic and Antarctic Alaska, Greenland, N Russia, Siberia and Kamtchatka, Scandinavia and Whaling. (Short List B 5) Pp. 16. (London Francis Edwards, Ltd)

Diary of Societies

FRIDAY, FEBRUARY 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Sir St. Clair Thomson, F C Ormerod, and others Discussion on Tuberculosis of the Ear

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4 30.—The Escape of Radiation from the Atmosphere. Chairman, Sir Gilbert Walker Opener, Dr G C Simpson, followed by Sir Napier Shaw, Dr F J W Whipple, and Prof E A Milne.

EMPIRE SOCIETY, at 4 30.—J A Richey The Indian Educational System.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4 30.—Discussion on Frontal Sinusitis and its Treatment.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—H E. Beckett The Radiation Reflecting Powers of Rough Surfaces.—E B Moss A Ballistic Recorder for Small Electric Currents.—F J Scrase The Instrumental Phase Difference of Seismograph Records.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H N Gresley High pressure Locomotives

COKE OVEN MANAGERS ASSOCIATION (Midland Section) (at Grand Hotel, Sheffield), at 6 30.—A. Grounds Some Aspects of Coal Treatment.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Midland Hotel, Manchester) at 6 30.—C J H Trutch The Diesel Engine and the Railways.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of the Rubber Industry) (at Engineers Club, Manchester), at 7.—A Fraser Plant Used in the Manufacture of Synthetic Resins.—Dr E E. Walker and E A Bevan The Effect of Certain Factors upon the Electrical Properties of Moulding Powder and Synthetic Resins.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—R. Davis G W Bowdler and W G Standring The Measurement of High Voltages, with special reference to the Measurement of Peak Voltages.—Dr L E Ryall The Construction and Operation of a Simple Neon Tube High Tension Crest Voltmeter.—S Whitehead and A. P Castellain Sphere Gap Calibration

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Literary and Philosophical Society Newcastle upon Tyne), at 7.—Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Members Evening

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30.—J W White Aerial Wire Ropeways

INSTITUTE OF FUEL (Bristol Centre) (at Bristol University) at 7 30.—M H Lewis Recent Developments in Economy of Fuel for Small Boilers

GEOLOGISTS ASSOCIATION (in Botany Theatre University College) (Annual General Meeting), at 7 30.—Prof W W Watts Bournes (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8 30.—A D Wright Spinal Analgesia, with special reference to Operations above the Diaphragm

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J M Keynes The Internal Mechanics of the Trade Slump.

INSTITUTE OF BREWING (North of England Section) (Annual General Meeting) (at Midland Hotel Manchester).

SATURDAY FEBRUARY 7

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr E Cammaerts Flemish Art (3) Rubens

MONDAY, FEBRUARY 9

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, at 5.—Dr D K Henderson Social Psychiatry (Morison Lectures) (1)

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R W L Phillips and others Discussion on Maintenance Service to Consumers in Rural Areas

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne), at 7.—P J Ryle Two Transmission Line Problems Suspension Insulators for Industrial Areas in Great Britain Conductor Vibration

INSTITUTE OF METALS (Scottish Section) (at 39 Elmbank Crescent, Glasgow), at 7 30.—D R. Tullis Gas Refinement of Metals and Alloys

ROYAL GEOGRAPHICAL SOCIETY, at 8 30.—Mrs. Patrick Ness To Lake Chad and the Sahara.

TUESDAY, FEBRUARY 10

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15.—Sir William Bragg Recent Experimental Physics (1) The Raman Effect.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30.—Symposium on Salt Domes.

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, at 6.—H E. Yarrow and S Hunter, Jr Water tube and/or Scotch Boilers

Royal Sanitary Institute (at 90 Buckingham Palace Road), at 6.—Lt.-Col. W Butler and others Discussion on Recent Methods of Sewage Treatment.

Institute of Metals (Swansea Section) (at Y M C A., Swansea), at 6 15 —J Frith Application of Copper to the Building Trade

Society of Chemical Industry (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6 45 —J H S Dickenson The Manufacture of Heavy Steel Forgings for the Chemical Industry

Institution of Electrical Engineers (East Midland Sub-Centre) (at Loughborough College), at 6 45 —S G Brown Loud Speakers since their Conception with Gramophone Pick ups and Wireless Recording Apparatus

Institution of Electrical Engineers (North Midland Section) (at Hotel Metropole, Leeds), at 7 —Informal Discussion on Earthing and the Safety of the Public, with special reference to Domestic Apparatus

Institution of Electrical Engineers (North Western Centre) (at College of Technology, Manchester), at 7 —Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture).

Institution of Electrical Engineers (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7 —O Howarth The Metering of Three Phase Supplies

Institute of Fuel (at 17 Albert Square, Manchester), at 7 —Dr G V Slottman Fuel Control in the Iron and Steel Industries.

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Section) (at Borough Polytechnic) at 7

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Section) (Manchester and District Branch) (at Milton Hall Manchester), at 7 —C M Oates Panel Heating

Royal Photographic Society of Great Britain, at 7 —Colour Photography

Institution of Automobile Engineers (at King's Head Hotel, Coventry) at 7 30 —S W Nixon The Compression Ignition Automobile Engine

Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent Glasgow) at 7 30 —G Wahl Electric Welding in the Construction of Sea going Vessels

Institute of Metals (North East Coast Section) (at Armstrong College, *Newcastle upon Tyne) at 7 30 —A. Wragg Stress in Metals*

Quekett Microscopical Club (Annual General Meeting) (at Medical Society of London), at 7 30 —Presidential Address

Royal Anthropological Institute at 8 30 —H J Hogbin The Spirits of the Dead at Ongtong, Java

WEDNESDAY, February 11

Institution of Heating and Ventilating Engineers (at Hotel Russell Russell Square), at 2 30 —W G Case and W E Dennison Boilers and Metals

Royal College of Physicians of Edinburgh at 5 —Dr D K Henderson Social Psychiatry (Morison Lectures) (2).

Geological Society of London, at 5 30

Television Society (at University College) at 7 —E L Gardiner The Stenode Radiostat and its Application to Television

Halifax Textile Society (at White Swan Hotel Halifax), at 7 30 —N L Hudson The Use of Liquid Fuel in the Textile Trade

Royal Society of Arts, at 8 —F G Wood New Motives for Textile Designs

THURSDAY, February 12

Royal Society, at 4 30 —Prof L T Hogben and D Slome The Pigmentary Effector System, VI —H Muir Evans Brains of Cyprinoids and Habits of Feeding

Royal Institution of Great Britain at 5 15 —Prof H Dingle The Nature and Scope of Physical Science (4).

Royal Aeronautical Society (at Royal Society of Arts), at 6 30 —Capt N Macmillan Air Navigation

Institute of Marine Engineers (Junior Section) at 7 —J Doonan The Manufacture and Uses of Monel Metal (Film Lecture).

Royal Photographic Society of Great Britain (Colour Group), at 7 —Informal Meeting

Burnley Textile Society (at Mechanics Institute, Burnley), at 7 15—R. Eastman Efficient Lighting

Society of Chemical Industry (South Wales Section) (jointly with Institute of Chemistry) (at Cardiff Technical College), at 7 30 —F J Dippy The Geochemistry of Coal

Institution of Electrical Engineers (Dundee Sub-Centre) (at University College Dundee), at 7 30.—J M Paterson Commercial Aspects of Electrical Engineering

Optical Society (at Imperial College of Science), at 7 30

Institute of Metals (London Section, jointly with Electroplaters and Depositors Technical Society) (at 83 Pall Mall), at 7 30 —Dr H J T Ellingham Electrolytic Processes in Metallurgy

North East Coast Institution of Engineers and Shipbuilders (Tees side Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30 —A Richardson The Modern Manufacture of Machine-cut Gears

Institution of Welding Engineers (at Institution of Mechanical Engineers), at 7 45.—Declaration of the name of the winner of the Operative Welders Prize and the awarding of the Prize and Gold Medal —The Prize Winner Welding Practices and Methods based on my own Experiences

British Psychological Society (at Royal Anthropological Institute), at 8.15 —Extraordinary General Meeting

Royal Society of Medicine (Neurology and Psychiatry Sections) at 8.30 —Special Discussion on Mental Symptoms associated with Brain Tumours.

FRIDAY, February 13

Royal Astronomical Society (Annual General Meeting), at 5 —Presidential Addresses by Dr A C D Crommelin on the award of the Gold Medal to Prof W de Sitter, and the Jackson Gwilt Medal and Gift to C W Tombaugh

Biochemical Society (at Lister Institute), at 5 —W T J Morgan: A Specific Precipitating Polysaccharide from *B. dysenteriæ* (Shiga).—L F Hewitt Oxidation Reduction Potentials of Pneumococcus Cultures.—B C. Guha Investigations on Vitamin B_2.—E. Boyland and O Meyerhof Glycogen Synthesis in Muscle Poisoned with Mono-iodoacetic Acid —Gladys Bird and P Haas The Cell Wall Constituents of Laminaria. Mannuronic Acid —M G Macfarlane The Influence of Potassium Mono-iodoacetate on Fermentation by Yeast Preparations —R. Robison and E. J King Hexosemonophosphoric Esters —W Robson and J Lamb The Erlenmeyer Synthesis of Amino-acids

Royal College of Physicians of Edinburgh, at 5.—Dr D K Henderson Social Psychiatry (Morison Lectures) (3).

British Psychological Society (Æsthetics Section) (at Bedford College) at 5 30 —R Ellis Roberts Reality in Life and Literature

Malacological Society of London (at Linnean Society), at 6.

North-East Coast Institution of Engineers and Shipbuilders (at Mining Institute, Newcastle upon Tyne), at 6 —W C S Wigley Ship Wave Resistance—an Examination and Comparison of the Speeds of Maximum and Minimum Resistance in Practice and in Theory

Society of Chemical Industry (Chemical Engineering Group) (at Institution of Civil Engineers), at 6 30 —D MacDonald Silver and its Application to Chemical Plant

Institution of Locomotive Engineers (London) (at 36 George Street Manchester), at 7 —D W Sanford The Development of the Piston Valve to improve Steam Distribution

Institution of Mechanical Engineers (Informal Meeting), at 7

Society of Chemical Industry (South Wales Section, jointly with Microscopical Society of Wales) (at Cardiff Technical College), at 7 30 —C A Seyler The Microstructure of Coal

Blackburn Textile Society (at Blackburn Technical College), at 7 30 —S N Duguid Smoke Abatement and Fuel Economy

Junior Institution of Engineers, at 7 30 —H C Reid Monolith Foundations.

Institute of Metals (Sheffield Section) (at Sheffield University), at 7 30 —N C Marples The Applications of High Nickel Nickel-Copper Alloys and Pure Nickel in Industry

Royal Institution of Great Britain, at 9 —Prof F Ll Hopwood Ultrasonics Some Properties of Inaudible Sound

Society of Chemical Industry (Glasgow Section, jointly with other Chemical Societies) (at Glasgow)

SATURDAY, February 14

Royal Institution of Great Britain, at 3 —J Stephens On the *Reading and Speaking of Verse (1) On Speaking Verse.*

PUBLIC LECTURES.

SATURDAY, February 7

Gilbert White Fellowship (at 6 Queen Square, W C 1), at 3 —Prof E J Salisbury Some Rarer British Plants and their Distribution

Horniman Museum (Forest Hill), at 3 30 —Dr F A. Bather The Cuttle Fish and its Ancestors

MONDAY, February 9

University of Cambridge (Cavendish Laboratory), at 4 45 —Dr Irving Langmuir Fundamental Phenomena in Electrical Discharges in Gases (Scott Lectures) (Succeeding Lectures on Feb 11, 13 16, and 18)

London School of Hygiene and Tropical Medicine (Public Health Division), at 5 —Col L W Harrison Venereal Disease Gonorrhoea

University of Leeds, at 5 15 —H B Butler Some International Aspects of the Economic Depression

TUESDAY, February 10

Imperial College—Royal School of Mines, at 5 30 —Dr F G Gregory Growth Problems in Plants. (Succeeding Lectures on Feb 17 and 24)

University College London, at 8 15 —Miss E Jeffries Davis Re plannings of London, c 1520–1920

WEDNESDAY, February 11

London School of Hygiene and Tropical Medicine (Public Health Division), at 5 —Col L W Harrison Venereal Disease Syphilis.

Royal Anthropological Institute (at Portland Hall, Great Portland Street W 1), at 5 30.—C O Blagden Peoples of British Malaya.

King's College, London, at 5 30 —Prof E Prestage The Great Age of Discovery (4) Vasco de Gama and the Way to the Indies

University College, London, at 5 30 —I C Grondahl Norwegian Life and Character (Succeeding Lectures on Feb 18 and 25)

Belfast Museum and Art Gallery, at 8 —Prof J K Charlesworth Big Animals of the Past.

THURSDAY, February 12.

Bedford College for Women, at 5 15.—*Mrs Brajlal Nehru* The Position of Women in India.

King's College, London, at 5 30 —S. P Turin Workers Family Budgets in Russia and Great Britain before and after the Great War

SATURDAY, February 14

Horniman Museum (Forest Hill), at 3.30.—Major G M Coombs Fiji and the Fijians.

CONFERENCE.

Wednesday, February 11

Conference on the Making of New Grassland Experiences of Practical Farmers (at the Rothamsted Experimental Station), at 11 30 a m —Chairman Earl de la Warr Speakers Prof F L Engledow, J Cruickshank, W M Findlay, J Keith, A. R. McDougal W S Mansfield, J Alston, C H Gardner, A. MacArthur

SATURDAY, FEBRUARY 14, 1931

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Science and Transport.

IN few if in any departments of civil or industrial life has applied science introduced more revolutionary changes in the last hundred years than in that of transport It would be difficult, however, to find any other aspect of civil life which has been allowed to develop along more haphazard lines or in which the utilisation of the results of scientific discoveries has been more divorced from scientific organisation and control One and a half million people, or nearly eight per cent of the employed population of Britain, are directly engaged in one or other of the branches of transport Regarded solely as an industry, it is, therefore, of the utmost importance that efficient management and wise administration should maintain the highest possible standard of efficiency and economic development of the transport industry From the wider view of transport as an integral and indispensable part of the national structure, it is impossible to exaggerate the importance of adequate, efficient, and cheap transport facilities, particularly in a country such as Great Britain, in which trade consists so largely in the importation of food and raw materials and the exportation of manufactured goods

The Royal Commission on Transport alludes in its recently published final report * to the casual and haphazard way in which earlier forms of transport, particularly road transport, have been allowed to develop, and while regarding air transport as outside the scope of its inquiry, expresses the hope that timely guidance will ensure the development of this infant form of transport along sound lines Many of the main difficulties in the present situation are indeed, as in the case of London, the result of lack of vision on the part of everyone concerned The continued unchecked or uncontrolled development of road transport in competition with rail transport will undoubtedly have very serious evil results, and, apart from affecting the financial stability of those who provided transport facilities, will also hamper the economic progress of the nation

The case of the railways provides a classic example of the burden which ignorance and prejudice can place on posterity, and the extremely high prices which in the nineteenth century our railways were compelled to pay for land to buy off influential opposition are an important factor in their present-day difficulties, and one from which other countries are relatively free It is to be hoped that the lesson has been sufficiently well learnt to ensure general support for the Commissioners' recommendations

* London H M Stationery Office Cmd 3751

regarding compensation in the case of privately owned bridges carrying public highways

The report by no means holds the railways free from responsibility for some of their present difficulties To some extent the 'grouping' under the Railway Act of 1921 is unscientific and not sufficiently geographical To scientific minds the criticism in regard to the speed of railway journeys, particularly long-distance runs, will appear not a little scathing, and the railways are reminded that facilities create traffic

On the broad issues as between road and rail transport, the report stresses the advantage of rail transport in the case of long distances and heavy loads, and few of the recommendations can be more unquestionable than that which asserts that it is not in the national interest to encourage the diversion of heavy goods traffic from the railways to the roads Such diversions add greatly to the expenditure on highways, and tend to make the railways unremunerative without conferring any commensurate advantage As regards long distance travel, the railways have not made full use of their immense advantage of speed, and there is little doubt that with a little more attention to the amenities of railway travel on the lines recommended, medium- and long distance passenger road transport would largely disappear as a result of diminished demand

The report considers that much of the competition between road and railway and other forms of transport is due to the fact that the wages and general conditions of service in the road haulage industry leave much to be desired, and Sir W G Lobjoit's reservation on the recommendation for licensing of road hauliers was due not to any doubt as to the unsatisfactory conditions of wages and of labour, but to doubts as to the possibility of imposing conditions upon small firms and owner drivers The labour aspect of road transport is, indeed, of fundamental importance, not only from the economic aspect in securing fair and satisfactory conditions of wages and hours of work, as well as in eliminating unfair competition and diversion of traffic into channels not to the public advantage, but also from the safety point of view Insufficient attention has been given to the health and general physical fitness of transport drivers In particular, the establishment of hostels or rest-houses for long-distance drivers, who form one of the occupational classes most highly infected with venereal disease, is a provision much needed if the efficiency of the driver is to be maintained and this serious factor in the causation of road accidents eliminated

On the policy adopted by the railways of meeting road competition by themselves developing road transport, the Commission, while welcoming it so far as better co ordination of rail and road transport is secured, makes the trenchant comment that the large capital sums expended in establishing such services would be better applied to the electrification of suburban lines It is to such electrification, the improvement of omnibus services, and possibly to tube railways, that the Commissioners obviously look for the handling of the passenger traffic in large cities like London, Glasgow, Liverpool, Manchester, etc, at certain 'rush' hours, in place of the tramway systems, which they condemn as obsolete

An important feature in transport development to which the report directs attention is that of research on road problems and the ceaseless endeavour to ensure that the highway is adequate not only for the traffic it has to bear at the present time, but also for that which it is likely to carry in the future Much valuable research is being carried out by the Ministry of Transport, with the collaboration of the National Physical Laboratory, on such matters as the effects of varying certain factors in the design and construction of concrete roads, the conditions which give rise to the skidding of vehicles, and the effect of variations in the wheel diameters in the damage caused to roads To enable experiments to be carried out under practical conditions without interference from general traffic, and to enable particular road surfaces to be studied under known traffic conditions, a special experimental road has been constructed near an experimental station

Experiments have been carried out on glare on roads and on other problems of illumination relating to transport under the Illumination Research Committee of the Department of Scientific and Industrial Research The Bridge Stress Committee, in co operation with the railway companies, has carried out an investigation on stresses in railway bridges, in which 52 bridges were tested and some forty different types of locomotives used, the work resulting in the withdrawal from service of certain classes of locomotives and in improved locomotive designs to reduce the unbalanced vertical forces responsible for the 'hammer-blow' and the resultant dangerous oscillations in bridges, as well as in the development of practical formulæ for bridge designers These and similar activities assist the development of modern methods of transport on scientific lines, and the condemnation of steel tyres and the recommendation that all mechanically propelled vehicles using the roads, other than light

and heavy locomotives and steam rollers, should be fitted with pneumatic tyres, are essentially based on scientific investigation and evidence

The main difficulty, however, is that of securing action along the lines indicated by scientific and impartial examination when a large number of authorities and interests, some of which may be seriously conflicting, are involved This is possibly illustrated by the failure of the Commission to make any real recommendation in regard to unification, the importance of which is clearly recognised Beyond the final recommendation for the appointment of a permanent Advisory Council on Transport, the discussion of co-ordination leads to no unanimous conclusion In this respect the report differs from the two earlier reports on "The Control of Traffic on Roads" and on "The Licensing and Regulation of Public Service Vehicles", the unanimous recommendations of which were practically all incorporated in the Road Traffic Bill which received Royal Assent on Aug 1, 1930 As the report makes clear, however, the question of co-ordination and unification is of fundamental importance It must ultimately be determined largely on scientific principles, and the modern traffic problem is essentially one of those problems set by scientific developments the solution and control of which rests with scientific workers themselves

The Theory of Geological Thermal Cycles

The Surface-History of the Earth By Dr John Joly Second edition Pp xxi + 211 + 13 plates (Oxford Clarendon Press, London Oxford University Press, 1930) 8*s* 6*d* net

A BOOK which has for its chief object the exposition of a group of geological hypotheses of a highly speculative character is likely soon to become out-of-date as geophysical evidence accumulates and as quantitative criticism is applied to processes envisaged in the light of incomplete knowledge This fate rapidly befell the first edition of Prof Joly's well known book It is therefore of special interest to consider how the author has dealt with recent advances bearing on his theory of thermal cycles and with the various criticisms, adverse or constructive, that represent the reactions towards it of other workers in the same field Judged in this way, the second edition can only be regarded as disappointing

Any discussion of the distribution of the radioactive elements in the earth must be based on the nature of the rock-types entering into the layers of the crust and of the underlying substratum The xenoliths brought up from the depths by the kimberlite magma of the diamond pipes of Africa suggest that the downward distribution is from granitic and gneissic rocks through amphibolite and granulite to eclogite and peridotite Seismic evidence is consistent with such a sequence, but it fails to support Joly's new suggestion that the granite layer may be underlain by an anorthosite layer (p 64) Moreover, the diamond pipes have provided no samples that would lend support to this assumption Joly's view that eclogite is an important constituent of the upper part of the substratum is less hypothetical, but it is far from safe to assume that the radioactivity of such a layer is necessarily the same as that of the eclogites tested in the laboratory, since these occur for the most part in mountain belts where they owe their origin to exceptionally high pressure If the plateau basalts have been derived from the complete fusion of an eclogite layer, then the radioactivity of the latter is more likely to be represented by that of the former, as assumed in the first edition By regarding the radioactivity of the substratum as thermally equivalent to about one-third that of the plateau basalts, Joly now considers the period of liquefaction to be about three times as long as his original estimate Unfortunately, even this admission fails to make the consequences of the hypothesis consistent with the duration of geological time as estimated from lead ratios

Much more serious, however, is the fact that Joly's mechanism of alternating accumulation and discharge of heat seems to be physically unacceptable Jeffreys has vigorously attacked the hypothesis of thermal cycles, on the grounds that on the postulated conditions the substratum would remain permanently fluid, and that tidal drift of the crust would not occur at the required rate But even though the proposed mechanism for bringing about the discharge of excess heat is unsatisfactory, Joly has nevertheless rendered a most important service to geology by facing the probability that there *is* an excess of heat to be discharged, and that some form of crustal drift is necessary to avoid the *impasse* of a thermally expanding globe Possibly the underlying flaw in Joly's preliminary assumptions is his belief that because the substratum is now solid in the sense of being rigid and highly viscous, it is therefore necessarily crystalline It may not be, at least below a certain level, quite as probably it is in a glassy state Granting the latter assumption, which is difficult to resist from the thermal point of view, there is no difficulty in discharging heat

by convective circulation in the substratum combined with continental drift in the crust, the currents themselves providing the motive force for 'engineering' the drift Such a process has been already suggested (*Geol Mag*, May 1928, p 236), and it has apparently been overlooked by Joly when he says on p 99, "no imaginable physical system which results in conditions of steady heat-flow to the surface can account for those periodical events which are at the basis of geological history and which have hitherto constituted its most elusive problem"

Lotze has assailed both Joly's hypothesis and the modifications proposed by the reviewer in 1925 by confronting them with the actual complexities of earth history It must be admitted that an alternation in time of world-wide compression with world-wide tension cannot be readily admitted Tensional phenomena in some regions seem, on the contrary, to be contemporaneous with compressional phenomena elsewhere On the convection hypothesis this would be inevitable, on the theory of thermal cycles it remains inexplicable

Of the first edition of Joly's book it was possible to write, "Prof Joly's inspired originality should henceforth lead geology into a new phase" (NATURE, Dec 19, 1925, p 891) This forecast has already been amply justified, and although the second edition lags behind the progress that has been made possible by the first, the book remains a record of one of the most highly stimulating and suggestive contributions ever made to theoretical geology ARTHUR HOLMES

The Yellow-skinned Races of South Africa.

The Khoisan Peoples of South Africa Bushmen and Hottentots By Dr I Schapera (*The Ethnology of Africa*, edited by J H Driberg and Dr I Schapera) Pp xi + 450 + 16 plates (London George Routledge and Sons, Ltd, 1930) 31*s* 6*d* net

WE have long needed an authoritative work on the Bushmen and Hottentots of South Africa The former are an extremely important people for the ethnologist, and from them the Hottentots cannot be dissociated physically or culturally, hence the composite name "Khoisan" adopted by the author—Khoi = Hottentot and San = Bushman. We are therefore grateful to Dr Schapera for taking the trouble to assemble all the available data concerning these peoples and therewith to make a trustworthy and interesting book which will be indispensable for students

The Bushmen are relatively late-comers into South Africa from East Africa; they were preceded by the 'Boskopoid' race and doubtless by other races yet to be identified The Rhodesian man of Broken Hill, who belonged to a much more primitive race, is not mentioned, evidently as he did not contribute anything to the Khoisan Still later than the Bushmen came the Hottentots, they appear to have sprung out of a mixture of the old Bushman population of East Africa with an early immigration there of Hamites, who gave them cattle and those peculiarities of language by which they are distinguished from the modern Bushmen The southern Bushmen represent the purest type, while the northern tribes show some degree of intermixture with other peoples, as their greater stature and darker colour suggest

The Hottentots as a whole are a fairly uniform people, their skulls, according to Shrubsall, seem to indicate that there was a Bantu Negro mixture which perhaps took place before their arrival in South Africa The Korana branch of the Hottentots are somewhat aberrant, they certainly have absorbed much Bantu blood, but there seem to be cranial indications of a Boskopoid element in their composition

The greater part of the book deals with the culture of the Bushmen and Hottentots, which complicated subject is attacked by Dr Schapera in a workmanlike manner, as is to be expected from a former student of Prof A R Radcliffe-Brown The Bushmen have never been systematically studied by a trained ethnologist and the information is fragmentary and occasionally contradictory This has made it impossible to come to definite conclusions on many points, and it is to be hoped that these debatable matters will be settled by work in the field before it is too late, if it be not so already A noticeable feature of the book is that the physical conditions under which the people live and their economic life are given due prominence, and the inter-relationship of these with the socio-religious life of the people is not overlooked

The mimetic animal dances of the Bushmen were probably of a ritual character, but of their function and relation to the social life generally, scarcely anything is known Purely decorative art is rare and very poorly developed, but their pictorial art, consisting of paintings and engravings executed on rock surfaces, is well known It has for a long time been recognised that the paintings are of different styles and that some are superimposed on others, thus giving a relative chronology, recently Mr M. C Burkitt has demonstrated an interesting sequence,

but there is much yet to be discovered in studying a wider area

The only Hottentot people whose social organisation is at all well known are the Naman of the south-west, of whom a special study from this point of view has been made by Mrs A W Hoernlé Her description has been supplemented in several respects by the observations of other writers, so that it is possible to arrive at a fairly clear conception of the social structure of this division, but the original organisation of the other Hottentot peoples has long since been totally obliterated

There is ground for supposing that the Hottentots formerly revered the moon Apart from invocations to the moon, their religious cult seems to have centred mainly in the worship of heroes, derived partly from animistic beliefs, partly from a personification of the natural forces producing rain In a country like South Africa, where water is in places exceedingly scarce, it is not surprising that the annual rain ceremony is the most important religious ceremony of the Hottentots The Hottentot religious conceptions show in many respects a striking resemblance to those of the Bushmen The southern Bushmen to some extent stand apart from the rest, they share with the others the cult of the moon and several beliefs concerning the dead and natural phenomena, but the beliefs centring in the Mantis among the Cape Bushmen have no parallel farther north Their mythology is far more elaborate than that of the Hottentots, which in its turn is more developed than that of the northern Bushmen

There is a chapter on the difficult subject of the Khoisan languages, an exhaustive bibliography, and numerous excellent photographs If the other volumes of this series prove to be as good as this one, we shall have a very valuable collection of monographs on African ethnography

A C HADDON

Modern Farming in Germany

Handbuch der Landwirtschaft Herausgegeben von Fr Aereboe, J Hansen und Th Roemer Fünf Bände Lieferungen 12 25 (Berlin Paul Parey, 1929) 5 80 gold marks each part

NOW that the publication of this handbook is complete, it is possible to form the comprehensive view of the whole work that was defeated earlier by its fragmentary method of production With all the parts in hand, the objection based on non-consecutiveness is reduced to a problem for the bookbinder

The complete handbook is admirable One could not, if one wished, withhold admiration from a work on agriculture on a scale commensurate with the size of the subject here the five volumes cover more than 3000 pages, and weigh, unbound, some ten kilograms In addition to quantity, quality is undoubtedly present The specialists who contribute know their subjects, the aim of the whole work is both to lay a foundation for the farming of the coming hundred years and to help the industry through its present crisis, and even if this may seem a little ambitious, the result has been good While the book does not go deeply into fundamentals, on the practical side it covers the best of existing farming methods (using 'farming' in an extremely wide sense), describes ways of improving them, and introduces new ones The reference, not unnaturally, is almost always to German conditions, for English readers the book will be useful chiefly as a fund of information about German farming, both in organisation and in details of its execution Whenever one wants to know how so and so is done in Germany, it will be natural to turn first to this handbook

The twenty eight separate contributions that are included in the fourteen parts here assembled can scarcely be reviewed individually All the volumes except that dealing with the principles of arable farming (vol 2), which was completed in the earlier instalments, are represented that is to say, much of the economics of farming (vol 1) and of general animal husbandry (vol 4), almost the whole of crop husbandry (vol 3), with a special section on agricultural machinery, and of special animal husbandry (vol 5) In the first and fourth volumes the individual contributions cover a certain aspect of the general subject, while in the third and fifth volumes a single type of crop or live stock is described in each contribution

Many of the contributions are so thorough and informative that they are worth purchasing on their own merits investigators who would not in any case buy the whole handbook might be recommended to get the sections bearing on their own work Since the handbook was published in parts, this should easily have been arranged—but actually the method of production makes it decidedly difficult The obstacle, which has been referred to in a review of the earlier instalments, is a lack of correlation between the parts as published and the actual sections of the handbook, it could have been obviated when publication was complete by a summary table indicating the numbers of the parts in which each contribution appears This has not

been done, however, the information cannot be found either in the publisher's announcement or in the general table of contents printed in the cover of each instalment In consequence, the advantage from the reader's point of view of publication in separate parts has been lost

The Physiology of Micro-organisms.

Physiology and Biochemistry of Bacteria By Prof R E Buchanan and Prof Ellis I Fulmer Vol 1 *Growth Phases, Composition and Biophysical Chemistry of Bacteria, their Environment and Energetics* Pp xi + 516 34s net Vol 2 *Effects of Environment upon Microörganisms* Pp xvii + 709 34s net Vol 3 *Effects of Microörganisms upon Environment, Fermentative and other Changes Produced* Pp xv + 575 34s net (London Baillière, Tindall and Cox, Vol 1, 1928, Vols 2 and 3, 1930)

THE treatment of the subject, as may be seen from the size of the work, is exhaustive, yet the authors do not consider that they have presented more than an introduction to, or an outline of, our knowledge of the physiology and biochemistry of the bacteria, yeasts, and moulds In their opinion, many of the topics discussed could profitably be submitted to monographic treatment, but limitations of space prevented them from carrying out such an elaboration Their purpose, therefore, was to compile and systematise the material relating to the physiology of micro organisms, they have well succeeded in their monumental task The biblio graphies of literature cited run to 30, 110, and 140 pages respectively in the three volumes the whole work brings under one cover abstracts of papers scattered in a variety of journals, arranged according to the divisions of the subject selected by the authors The treatise forms, therefore, a very useful work of reference

Many will find the work also of value from another point of view, each section is preceded by a general discussion of the physical or chemical principles involved, which alone would be useful as an intro duction to certain aspects of biochemistry Thus there are extensive discussions of such subjects as the physical and physico-chemical characteristics of systems of various degrees of dispersion, the different types of energy and chemical thermodynamics, the velocities of chemical reactions and the effects of temperature changes upon them, the characteristics of certain electromagnetic waves and the characteristics of enzyme action and a classification of enzymes Free use is made of chemical formulæ throughout Whether such exhaustive discussions should find a place in a work of this type is perhaps doubtful, but there is no question as to their value for many workers who may not wish to be referred to the larger text-books of biochemistry

The titles of the volumes give some idea of the scope of the work, but further details may be given to illustrate its comprehensiveness In the first volume, a chapter is devoted to growth phases and growth rates in cultures of micro-organisms, in which may be found details of different methods of counting the numbers present in a given volume the subject lends itself to a mathematical treatment The chemical composition of the cells of micro-organisms is next considered the account of bacterial pigments forms an interesting section Brief reference is also made to the recent work on the antigenic polysaccharides The section on the physico-chemical characteristics of systems of various degrees of dispersion is one of the most complete in the book and includes discussions on the properties of true solutions, surface tension, adsorption, viscosity and osmotic pressure, on the Donnan equilibrium, on conductivity and hydrogen ion concentration and the electrometric and colori metric methods of measurement of the latter, and on the properties of colloids

From that point the transition to the agglutination of bacteria by various agents is natural and easy Reference is made to agglutinins, antitoxins, opsonins, and antibodies, familiar to the human pathologist and bacteriologist The final chapter of this volume deals with the energy relationships of bacteria, especially the energy changes in oxidations and reductions carried out by them, and the utilisation of energy in synthesis, in the production of light and of movement, as for example in chemotropism

The chapters in the second volume will be of interest to a wide circle of readers The effects of temperature, of rays and emanations, and of various physical environments are described in detail apart from the general scientific interest of the descriptions, human pathologists will find them of value from the point of view of the destruction of micro-organisms by the various agents cited, as well as of the changes in pathogenicity which can be induced In succeeding chapters the effects of the chemical environment are considered the treatment is systematic, inorganic compounds and their ions, non nitrogenous and nitrogenous organic compounds being taken in order Here the action of germicides may be found described in detail The presentation of the structural formulæ of all the

compounds considered lends an added value to these chapters in fact, they may be of use as a source of reference to those who wish to know the structure of a number of complex organic substances, including the antiseptic dyes

The third volume deals with the changes produced in various compounds by micro-organisms and the agencies by which these are effected one chapter is devoted to symbiosis The arrangement of the subject matter is on the same lines as in the second volume An important section is that dealing with fermentation Structural formulæ are again freely used

It is impossible in a short review to give more than an outline of the scope of the treatise, but enough has been said to show the wide appeal of the work It is up-to-date, although in a science which is advancing so rapidly, revision with our increasing knowledge will in places be required, as the authors themselves acknowledge Their desire that the work should indicate not only what has been accomplished, but also what remains to be done, appears to have been fully realised It should be in the hands of all bacteriologists, as well as of those who have to deal with similar chemical processes carried out by the higher organisms The volumes are clearly printed, and each is provided with three indexes, to authors, to subjects, and to micro-organisms

Our Bookshelf.

Guide to the Study of Animal Parasites By Dr William A Riley and Reed O Christenson (McGraw-Hill Publications in the Zoölogical Sciences) Pp xv + 131 (New York McGraw Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1930) 7*s* 6*d* net

This work is the outgrowth of Prof Riley's fifteen years' experience in presenting the main facts of parasitology to students in the laboratory The authors suggest that the first two practical periods should be devoted to a general survey of the parasites of the frog—*Trypanosoma* and *Lankesterella* (wrongly spelt throughout the book) in the blood, Helminthes in the lungs, alimentary tract, and bladder, and Protozoa in the large intestine and kidney Attention is then directed to the Trematoda, represented by *Polystomum*, *Clonorchis*, and *Fasciola*, and a key to the chief groups of cercariæ is added The study of cestodes begins with that of *Tænia pisiformis*, after which the human tænias and representative species of *Hymenolepis*, *Dipylidium*, *Diphyllobothrium*, *Multiceps*, and *Echinococcus* are briefly considered *Ascaris*, the hookworms, *Trichinella*, and *Trichuris* are the Nematoda chosen for examination

Instructions are given for the examination of fæces for eggs (with a key to the eggs of helminthes in human fæces) and of small mammals for adult worms The section of the work on Protozoan parasites deals successively with *Entamœba histolytica* and *coli*, *Trypanosoma lewisi*, *Giardia* and other flagellates, *Monocystis*, *Eimeria*, human and avian malaria, *Babesia*, *Sarcocystis* and the ciliates of the frog's rectum Suggestions are added on the use of text books, journals, and indices relating to parasitology, on the collecting, preservation, and mounting of specimens, lists are given of the more important parasites of the cat, dog, pig, sheep, rabbit, rat, fowl, and frog, the organ infected being indicated, references to works on parasitology, chiefly in English, are appended, and there is an adequate index

The lists of parasites would have been shortened without impairing their value to the student by omitting species rarely recorded *Sarcocystis*, common in the muscles of the sheep and the rat, and perhaps the trypanosome not infrequently present in the blood of the rabbit, might have been included in the lists

The information and instructions set forth in the book, supplemented, as no doubt is the case, by additional details on anatomy and life-history given in the laboratory, form a sound practical guide to the beginner in parasitology

The Unknown Self a New Psychological Approach to the Problems of Life, with Special Reference to Disease By Dr Georg Groddeck Pp 207 (London The C W Daniel Co, 1929) 7*s* 6*d* net

This little volume has been translated with the object of introducing the point of view of Dr Groddeck to English readers It consists of a series of short papers written at different times and for different audiences, but all informed by the same spirit He has sought to understand *why* people get ill, in order to help them to get well Although in sympathy with, and an exponent of, the psycho analytic theory, yet he cannot be located to any one school of thought or therapeutic practice He is in line with the thinkers who, at various times, have arisen as rebels against an intellectualism that would interpret the whole human being on materialistic lines

The elusive prospect of being able to comprehend humanity on mechanical principles has always appealed to some thinkers Galen in the second century criticised the narrow mechanical school of the methodists, while the misdirected application of the brilliant development of the so-called mechanical sciences in the seventeenth century stimulated Stahl to his polemical defence of a unifying animating principle over and above the machinery of life Groddeck postulates an unknown and for ever unknowable force in man, which, for purposes of exposition, he calls the 'It' The It is not merely the unconscious of the psycho-analytic school, but "includes both conscious and unconscious processes and holds absolute sway over the activities which it has built up There is no opposition between the ego and the It, rather is the ego a function of the It" No adequate definition

of the It can be given, but the author maintains that the reality of its existence is demonstrated constantly in everyday life, which "is an uninterrupted revelation, a continuous self-exposure of the It"

The first part of the book is concerned with setting out the more theoretical aspects of the theory, while in the clinical communications the application of the theory to the diagnosis and treatment of various common complaints is given While there is much in the book that readers will find difficult to understand, they will not find it dull, while even the orthodox, if they are not too old in thought, will find it stimulating and challenging

Elements of Forestry By Franklin Moon and Prof Nelson Courtlandt Brown Second edition, revised and reset Third printing, corrected Pp xvii + 409 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1929) 17*s* 6*d* net

MOON and Brown's "Elements of Forestry" has had a wide popularity in the United States First published in 1914, a second edition was issued in 1924, and now a revised and corrected third printing In this latter, the entire text has been revised and corrected, particularly with reference to up to-date statistics, new facts made available or recently determined, and in other ways the text has been brought up-to-date The authors state that they "have purposely left out many statistics and figures, such as prices, which change from time to time" In a book presumably used as a text book this is a wise decision, which the authors' experience since the first publication of the book will have shown desirable

The scope of this book is far wider than any of its type we remember in Britain The range of sub jects dealt with in its 387 pages (omitting appendices) covers the whole business of forestry from the elements of sylviculture (after a preliminary chapter on forestry and its meaning and importance), forest protection, forest mensuration, lumbering, wood utilisation, wood technology and preservation, forest economics, and forest finance A description of the United States Forest Service and the State forest activities follows, the book concluding with some regional studies of forest regions in the United States For anyone possessed of some considerable knowledge and training in forestry and what it aims at, this book should prove of very great interest and merits its popularity Whether it is equally useful for the student is perhaps more doubtful—since the treatment of many of the branches dealt with has of necessity been brief, condensed, and rather perfunctory, owing to the limits of space placed upon the authors

A Text Book of Economic Zoology By Prof Z P Metcalf Pp x + 392 (Philadelphia Lea and Febiger, 1930) 4 dollars

THE chief interest in foreign text-books is to see how other peoples meet problems of education In a southern agricultural State such as North Carolina, which stretches from the Allegheny Mountains to Cape Hatteras, it is important that students should be taught about the pests and parasites of man and his crops But it is still more necessary in a higher educational college that the professor should make his students think for themselves The author's science is 'systematised knowledge', but facts are barren to the student unless he is helped to consider the laws and proximate causes relating to them Surely here the professor is attempting an impossibility in dealing with the phyla of the animal kingdom in rotation, defining their characters, etc, without his class having acquired any knowledge of the anatomy of any animal in relation to the functions common to all animals There is, too, a lack of balance, 37 pages of bird classification as compared with 3 pages for fish, while important diseases like bilharzia, sleeping sickness, hookworm, etc, surely deserve fuller treatment

The book has potentialities and its tables and illustrations are good, while the list of economic animals is very complete, especially the ticks and mites A central theme is necessary, but this we failed to find We suggest that a short discussion of the facts of evolution and heredity is essential to the intelligent reading of a text book of zoology

A Study of the Oceans By Prof James Johnstone Second edition Pp viii + 235 (London Edward Arnold and Co, 1930) 10*s* 6*d* net

PROF JOHNSTONE'S study of the oceans is brief but it touches many aspects of the subject After a chapter on the origin of the earth and the geological history of the oceans and continents, he goes on to discuss the classical geography of the oceans, tracing the development of knowledge, mainly of the superficial extent of the oceans, up to the present time The second half of the book contains chapters on the physical and human geography of the great ocean basins No one could complain of lack of interest in the volume, but it is possible to suggest that too much has been tried within the compass of some two hundred pages The present issue is the second edition, which differs from the first mainly by the addition of a number of short appendices on isostasy, the Wegener hypothesis, methods of navigation, and the tides There are numerous sketch maps

La photographie d'amateur Par Dr Rémi Ceillier (Bibliothèque pratique de l'amateur) Pp 96 (Paris J-B Baillière et fils, 1930) 6 francs

THIS little book contains a considerable amount of useful information on photographic apparatus and the use of it, and the photographic processes that amateurs are generally interested in It will help the photographer to understand his work We think it is a pity that the book has no index, and that the table of contents consists only of the short headings of the seven chapters of which it consists Some of the lesser-used printing methods, such as carbon, bromoil, etc, are passed over with a mere mention, presumably so that the space available may be devoted to the more important subjects of lenses, cameras, and negative-making

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*]

Constitution of Osmium and Ruthenium

THESE two elements yield volatile tetroxides and by means of these their mass-spectra have now been obtained Osmium tetroxide was first experimented with, its action on the discharge, even in the smallest amounts, is quite amazing The whole mechanism of current flow is violently disorganised and only slowly recovers In consequence the admission could only be by very small periodical doses during the exposure, and it was only with the greatest difficulty that spectra of adequate density were obtained These indicate four strong isotopes and two very weak ones, one of the latter being isobaric with tungsten, W^{186} Fortunately it was easy to photograph on the same plate several short exposures of the mercury group, which is sufficiently near in mass to provide a reasonably reliable density scale The mass numbers and provisional relative abundance are as follows

Mass number	186	187	188	189	190	192
Percentage abundance	1 0	0 6	13 5	17 3	25 1	42 6

Lines at 206, 208 due to OsO are close enough to Hg 202, 204 for a rough value of the packing fraction of osmium to be obtained This appears to be $-1\ 0 \pm 2\ 0$, about that expected These results combine to give a chemical atomic weight of $190\ 31 \pm 0\ 06$ and suggest that the present one of 190 9 is considerably too high

Operations which were difficult with the osmium compound were found to be nearly impossible with that of ruthenium Not only did the vapour rapidly attack the grease of the admission stopcock, but also the presence of mercury in the doubly charged form interfered seriously with the identification and measurement of the ruthenium lines Every device was tried to eliminate the mercury lines, but only on one spectrum were they so reduced that it was possible to draw conclusions that ruthenium had six isotopes with the possibility of an extremely faint seventh The following figures, which are only rough estimates from the photometry of the faint lines, are the best available

Mass number	96	(98)	99	100	101	102	104
Percentage abundance	5	?	12	14	22	30	17

Assuming the packing fraction to be about -6, these give an atomic weight of 101 1 The present chemical value is 101 7, but as the lines 99, 100, and 101 are certain to have been enhanced a little by mercury, although its lines at 99 5 and 100 5 could not be seen, the divergence can be partially accounted for Of the isobaric pairs 96, (98), 100 which ruthenium forms with molybdenum, the first is of unique interest, for should the doubtful isotope of zirconium (Zr^{96}) be confirmed, there would exist an isobaric triplet, an occurrence of great interest and so far unknown F W ASTON

Cavendish Laboratory,
Cambridge, Jan 31

Spectrum of Cosmic Rays

SINCE 1928 I have been carrying out experiments on the absorption of cosmic rays in Lake Constance, which is 250 m deep and lies 395 m above sea level I was able to follow the cosmic rays to a depth of 236 5 m Analysis of the absorption curve showed four components of different penetrating power

The results were obtained by means of a registering electrometer specially designed for this purpose, which combined a wide range with great sensitivity The declining throw of the filament was registered on a stationary photographic plate by means of a lamp that illuminated the filament for a few seconds once an hour from the side, thus giving a bright line on a dark background The electrometer was connected to an ionisation chamber consisting of a steel cylinder of 33 5 litres capacity and 1 cm thick filled with carbon dioxide at about 30 atm pressure The entire apparatus could be made water tight, and was anchored in the middle of the lake and suspended at various depths with the help of floats

The first experiments, in October and November 1928, showed that the cosmic rays could be traced and measured to a greater depth than R A Millikan and C H Cameron have stated (Cf *Phys Rev*, **31**, p 921, 1928) These authors found that between the depths of 57 m and 67 m below the surface of the atmosphere no further decrease in ionisation could be observed in their apparatus On the other hand, my observations of 1928 showed (cf *Naturw*, **17**, 183, 1929)

At a depth of	78 6 m	an ionisation of		1 65	volts per hour	
,,	105 2	,,	,,	1 31	,,	
,,	153 5	,,	,,	1 00	,,	
,,	173 6	,,	,,	0 93	,,	
,,	186 3	,,	,,	0 89	,,	
,,	230 8	,,	,,	0 83	,,	

Subsequent experiments in the winter of 1929–30 proved that the decrease in ionisation at greater depths had not been caused by a decrease in the radioactivity of the water towards the bottom of the lake In these experiments the ionisation chamber was enclosed in a protecting tank 2 5 m in diameter, which was filled with water from the surface of the lake When the apparatus was sunk to various depths a constant layer of water 1 m thick shielded the ionisation chamber from the radioactivity of the water outside The results

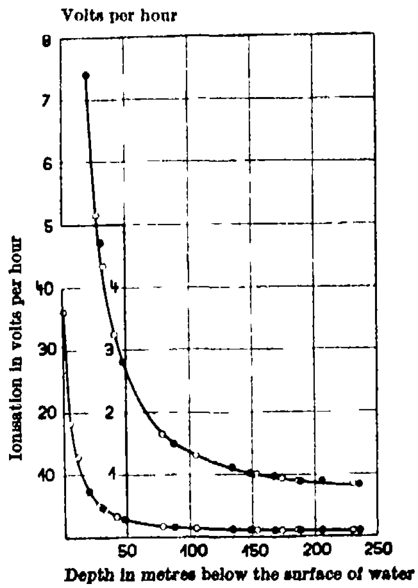

FIG 1

obtained in this way are in complete agreement with the curve plotted in 1928 without the protecting tank, a slight correction of 0 05 volt per hour being applied to account for the altered residual ionisation The former values are thus shown to be independent of the radioactivity of Lake Constance Fig 1 shows all the

points obtained, those without the tank being marked by circles the others by black dots The experiments below 20 m of water are reproduced on a tenfold scale Fig 2, showing the values below 75 m of water

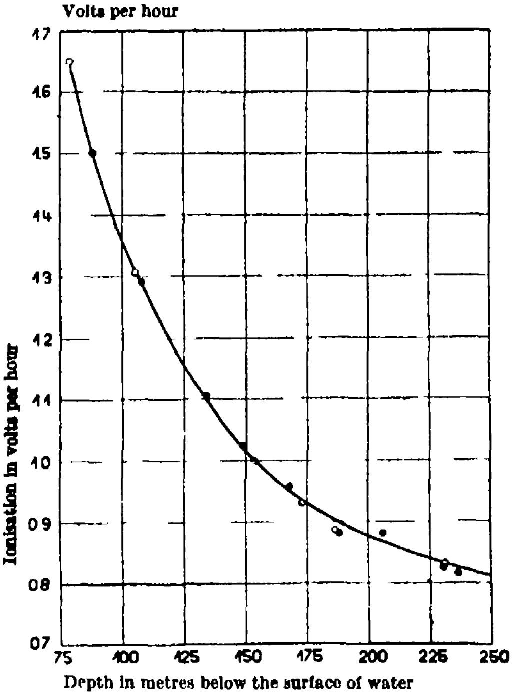

FIG 2

on a still larger scale may serve to illustrate the accuracy of measurement

In August and September 1930 the results were tested again with the help of a Geiger Muller electron counter tube which was sunk to various depths and acted on an electric clock the dials of which were photographed automatically at fixed intervals The results obtained are given in the following table

Depth in m below surface of water	Total period of the series of registrations	Average number of impulses per hour	
0	1 hour	7920	The residual impulses (about 500 per hour) due to the apparatus have been subtracted
(about 1)	[illegible]	5500	
(about 3)	[illegible]	4840	
7	[illegible]	3610	
9	1	3350	
18	[illegible]	2000	
34	3 hours	867	
93	4½	172 5	
133	4	88 5	
183	5½	52 5	
235	28	13	

From 7 m downwards the absorption curve of the cosmic rays obtained with the electron counter tube is in good agreement with that gained by the ionisation method Nearer the surface the readings of the electron counter tube are relatively too low This is probably due to the electrical and mechanical lag of the registering apparatus

The analysis of the absorption curve was made by my collaborator Herr W Kramer assuming incidence of the rays from all directions and taking the scattered radiation into account (cf H Kulenkampff, *Phys Zeits* **30**, 561 1929) Four components resulted The relative intensities of the hardest three components on entering the atmosphere are 0 81 6 4 16 35, the hardest radiation being the least intense. The true absorption coefficients are 0 020, 0 073, and 0 21 respectively per metre of water The fourth component, with the longest wave length, could not be determined numerically

According to Klein and Nishina's formula, the wave-length of the hardest component is $0\ 63 \times 10^{-13}$ cm, whereas the complete transformation of a proton and an electron into radiation would correspond to a wave length of $1\ 313 \times 10^{-13}$ cm

E REGENER

Physikalisches Institut der technischen Hochschule,
Stuttgart, Jan 13

Excitation Probabilities of Singlet and Triplet States

IT has long been known from experimental evidence[1] that triplet states in the spectra of two electron systems differ from the corresponding singlet states in their behaviour to electron impact The probability of excitation of a triplet level has a sharp maximum for electron energies just above the excitation potential whereas in the case of singlets the maximum probability is not sharp, and occurs at energies considerably beyond the resonance potential, also, for high velocities the triplet excitation is negligible compared with the singlet excitation The difference must lie in the fact that the triplets can only be excited from the ground state by electron exchange, and Oppenheimer[2] has shown in general how this may be approximately calculated

Using this theory and wave functions given by variation methods[3] we have calculated the probability of excitation of the 2^3P and 2^1P states of helium as a function of the velocity of the exciting electrons The curves obtained are shown in the accompanying diagram (Fig 1) and exhibit the above

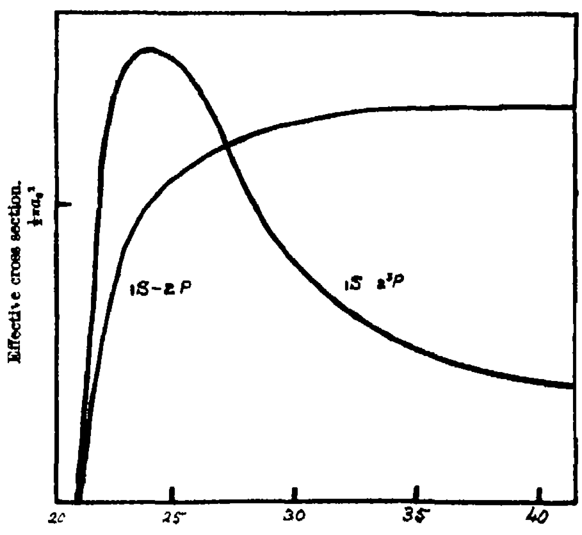

FIG 1 —Excitation probabilities of singlet and triplet P states of helium The ordinates for the singlet have been halved, to facilitate comparison

$a_0 = 0\ 53 \times 10^{-8}$ cm the radius of the first Bohr orbit of hydrogen

mentioned characteristics No high accuracy is claimed for the absolute values owing to the approximate nature of Oppenheimer's theory, but it seems clear that quantum mechanics adequately describes the phenomena

A detailed account of this work will be published

later, with calculations already in progress for other levels, including the effect of exchange on elastic scattering The probability of dissociation of hydrogen molecules by electron impact into two neutral atoms in the ground state, which is a similar process to the excitation of triplet states, is also being considered

H S W MASSEY
C B O MOHR

Trinity College, Cambridge,
Jan 21

[1] Hanle, *Zeit f Phys*, **56**, 94, 1930 Skinner and Lees, NATURE, **123**, 836, 1929 Schaffernicht, *Zeit f Phys*, **62**, 106, 1930
[2] *Phys Rev*, **32**, 361, 1928
[3] Eckart, *Phys Rev*, **36**, 878, 1930

The Crystal Structure and Polymorphism of Hydrogen Halides.

IN a previous letter to NATURE (July 19, 1930, p 97) I communicated some preliminary results upon the crystal structure of hydrogen iodide I have now repeated, with greater accuracy the X ray examination of this substance, in order to investigate the discrepancies previously observed in certain values of the lattice dimensions, and have also examined solid hydrogen chloride and bromide at different temperatures, using, for X ray examination, the same apparatus as previously described (NATURE, Mar 22, 1930, vol 125, p 457, *Rend Acc Lincei*, vol 11, p 679)

The results obtained for hydrogen chloride agree, in the main, with those of Simon and Simson (*Zeitschrift f Physik*, vol 21, p 168), with the exception that the a constant of the cubic modification, stable over 98° abs, has been found to be smaller than that obtained by them, namely, $a = 5\ 44 \pm 0\ 01$ A at the transition temperature (instead of 5 54 at 103° abs by Simon and Simson) The volume of the elementary cell is then 161×10^{-24} c c, the density, for a cell containing 4 molecules, is 1 49, which is in better agreement with the experimental density (1 47) than their calculated results

The modification of hydrogen chloride stable at lower temperature was examined by cooling the capillary of the spectrograph with liquid nitrogen The photogram taken at 85° abs shows numerous lines, of which only a certain number correspond to the tetragonal system for an axial ratio $c/a = 1\ 10$, and for one side of the base of the elementary prism $a = 5\ 27$ A Most likely this modification of hydrogen chloride possesses a lower symmetry, perhaps rhombic, with axial ratios near those belonging to the tetragonal system

Hydrogen bromide, like the chloride, is dimorphous The modification, stable at high temperature, shows at 100° abs a face centred cubic structure The side of the elementary cell is $a = 5\ 77$ A, the volume 192×10^{-24} c c, the density, for a cell of 4 molecules, 2 78

The low temperature stable modification shows tetragonal symmetry, with an axial ratio $c/a = 1\ 10$, and with a basic side $a = 5\ 55$ A, or perhaps a pseudo tetragonal structure with ratios very little different from those of a tetragonal one The volume of the cell is 188×10^{-24} c c at 90° abs

Various photograms of hydrogen iodide have been taken, cooling in succession the capillary of the spectrograph with liquid hydrogen chloride (188° abs), methane (112°), oxygen (90°), nitrogen (77°) Hydrogen iodide was prepared by the action of iodine upon red phosphorus I have succeeded in getting much better defined photograms than before They contain many lines which cannot be ascribed to iodine impurities originating from photochemical decomposition of hydrogen iodide, as I thought at first, and which cannot be arranged in a cubical structure On the other hand, following this hypothesis, some divergences could be observed between the calculated and the experimental lattice distances. I have thus come to the conclusion that hydrogen iodide does not show, as I had previously considered, a face centred cubic structure, but a face-centred tetragonal structure with an axial ratio not much differing from the cubic one As a matter of fact, all lines of the photogram can be assigned to a face-centred tetragonal structure, with an axial ratio $c/a = 1\ 08$ and a side of the elementary cell $a = 6\ 10$ A at 100° abs The volume of the cell is 245×10^{-24} c c, and the density, for a cell of 4 molecules, 3 45 (The present values do not differ much from those previously calculated for a cubic structure)

From the lattice constants of the cubic modifications of hydrogen chloride and bromide the ionic radii of chlorine and bromine can be calculated, assuming the ions to be tangential in the face centred cubic lattice the new values are somewhat higher than Goldschmidt's values calculated from the alkaline halogenides ("Geoch Verteilungsgesetze d Elem", *Norsk Vid Ak*, 7, 1926), but they are perfectly consistent, as previously pointed out by Nasini and myself (NATURE, Mar 22, p 457, June 14, p 889, 1930 *Rend Acc Lincei*, vol 11, p 1009, vol 12, p 141, 1930), with the atomic radii of the inert gases having the same number of external electrons, as the following table shows

Cl = 1 81 (Goldschmidt),	1 92 (Natta)	A = 1 92 (Simon Simson)
Br = 1 96 ,,	2 04 ,,	Kr = 2 04 (Nasini Natta)
I = 2 20 ,,	2 21 ,,	X = 2 18 (Natta Nasini)

The 2 21 value of the iodine ion is obtained from the ratio of the volumes of the elementary cells of the isomorphous modifications of hydrogen iodide and hydrogen bromide, assuming as the bromine ionic radius that calculated from the cubic modification of hydrogen bromide We might also assume for the iodine ion a non-spherical form, as has already been suspected from the structure of other iodides

I cannot agree with Simon and Simson's hypothesis as to hydrogen chloride, and I assume that hydrogen halides show ionic structure and not molecular lattices as supposed by them This is proved by the agreement observed between the ionic radii of the free hydrogen halides and those of the alkaline halides The contraction suffered by the anion in the lattice of the latter must be ascribed to polarisation forces due to the alkali cation

G NATTA

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Royal Polytechnic, Milan,
Jan 17

Bands in the Spectrum of Boron Hydride

WITH the object of obtaining band spectra due to compounds of boron, we have investigated the radiation emitted by a condensed discharge in a tube through which a stream of BCl_3 was passed Besides the atomic lines of boron, chlorine, aluminium (from the electrodes), and hydrogen (perhaps due to HCl present in the BCl_3), we found a number of widely spaced bands in the neighbourhood of 4000 A, which we ascribe to the molecule BH Photographs taken in the first order of a 21 ft concave grating showed that these bands consist of single P, Q, and R-branches, the Q branch containing a considerable number of lines, and the lines $P(0)$, $P(1)$ being missing The bands must hence be considered as a $^1\Pi \longrightarrow {}^1\Sigma$ transition, probably corresponding to the $^1\Pi \longrightarrow {}^1\Sigma$ transition observed for AlH by Eriksson and Hulthén [1] The P- and R-lines of the strongest band are accompanied for higher rotational quantum

numbers by weak satellites due to the isotopic molecule $B^{10}H$ The frequencies of the principal lines, emitted by the molecule $B^{11}H$, may be represented with good approximation by writing for the rotational terms of the $^1\Pi$ state

$$T' = \nu_0 + B'(J+\tfrac{1}{2})^2 + D'(J+\tfrac{1}{2})^4,$$

for the rotational terms of the $^1\Sigma$ state

$$T'' = B''(J+\tfrac{1}{2})^2 + D''(J+\tfrac{1}{2})^4,$$

with

$$\nu_0 = 23073\ 60, \quad B' = \begin{cases} 11\ 938, \\ 11\ 908, \end{cases} \quad D' = -0\ 00147,$$

$$B'' = 11\ 798, \quad D'' = -0\ 00114$$

The two values of B' in the upper state arise from the fact that its rotational levels consist of two components each on account of Λ doubling Their difference increases proportional to $(J+\frac{1}{2})^2$ or practically proportional to $J(J+1)$ as required by the theory for $^1\Pi$ states [2] The lines of the Q branch start from the lower, the lines of the P and R branch from the higher ones of these components From the above values of B one finds for the moments of inertia $I' = 2\ 32 \times 10^{-40}$ gm cm^2, $I'' = 2\ 35 \times 10^{-40}$ gm cm^2, for the internuclear distances $r_0' = r_0'' = 1\ 23 \times 10^{-8}$ cm Although the moment of inertia is slightly smaller in the upper state, so that one expects at first that the bands would be shaded toward the violet and that the P branch would form the head, the fourth power terms in the formulæ for the term values reverse this behaviour and cause the R branch to form a head in the neighbourhood of $J = 24$ Since the moments of inertia differ so slightly in the two states, the lines of the Q branch lie at first extremely close together and only become resolvable for $J = 18$ on our photographs The band just discussed very likely is the $0 \longrightarrow 0$ band of the system Two weaker bands of the same general appearance with origins at 4367 A and 3696 A we believe to be the $1 \longrightarrow 1$ and the $1 \longrightarrow 0$ bands Full particulars, also as regards the analysis of these weak bands, will be published elsewhere

We wish to express our thanks to Dr Kronig for many valuable suggestions during the course of this investigation

W LOCHTE HOLTGREVEN
E S VAN DER VLEUGEL

Natuurkundig Laboratorium
der Rijks Universiteit,
Groningen, Jan 20

[1] *Zeit f Phys*, **34** 775, 1925
[2] See Kronig, *Zeit f Phys*, **50**, 347 1928 Hill and Van Vleck *Phys Rev*, **32**, 250, 1928

Spectra of Te IV and Te VI

FOLLOWING the identification of the doublet system of Se IV (reported in NATURE of Oct 11, 1930, p 568, and recently communicated to the Royal Society), the corresponding spectrum of tellurium, of the same chemical group, has been examined Vacuum spark spectra of the element, taken at Uppsala, in the region λ1400-λ400, have indicated the existence, among the lines of Te IV, of several pairs with separation 9222 cm^{-1}, which could be easily assigned to the configurations $5s^25p$, $5s^25d$, and $5s5p^2$ of trebly ionised tellurium

Three pairs with $\Delta\nu = 11{,}814$ cm^{-1} have also been identified as being $5^1S\ 5^3P$, 5^3P-6^3S, and 5^3P-5^3D of Te VI

Further details will be published shortly

K R RAO

Imperial College of Science and
Technology,
London, Jan 23

Change of the Electric Polarisation of Ethyl Ether with Temperature.

ONE of us has recently determined the changes of the dielectric constant E and density D with temperature T (J Mazur, NATURE, **126**, 649, 1930)

Starting from these data, we have computed, with the aid of the Clausius Mossotti formula

$$P = \frac{1}{D}\frac{E-1}{E+2},$$

the values of the dielectric polarisation of ethyl ether for the interval of temperatures between $-118°$ C and $+35°$ C The results of the computation are represented on the accompanying graph (Fig 1)

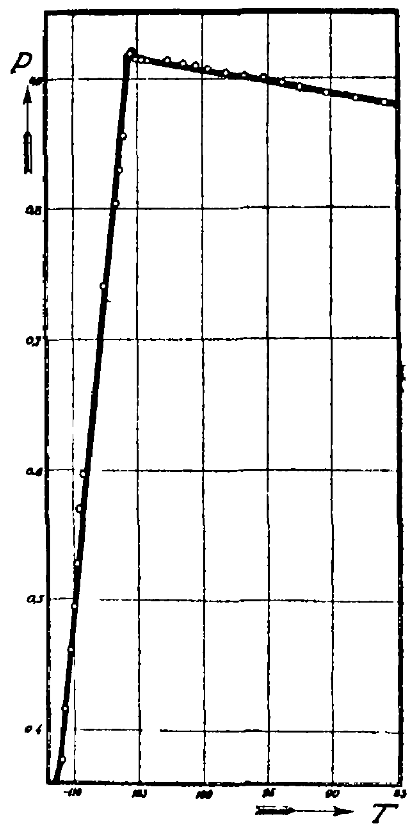

FIG 1

The value of the dielectric polarisation increases slowly with the lowering of temperature from 0 5858 at 35° C up to the maximum value 0 9209 at -105 4° C At this temperature there is a sharp decrease of the value of the polarisation

This very marked change suggests that at the transition point -105 4° C previously found by us (M Wolfke and J Mazur, NATURE, **126**, 684, 1930), the structure of the molecule of ethyl ether undergoes some modification The behaviour of ethyl ether at the point of change -105 4° C would thus differ from that of the helium (M Wolfke and W H Keesom *Comm*, Leyden, No 1, 92a) A further study of this phenomenon is being made

M WOLFKE
J MAZUR.

Physical Laboratory,
Technical Institute,
Warsaw, Jan 6

Species-Pairs among Insects.

ATTENTION has recently been directed to the water beetles *Deronectes depressus* F and *D elegans* Panz by F Balfour Browne in an interesting contribution to the *Scottish Naturalist* (Nov Dec 1930, pp 172 188) In a previous study (*Ann Mag Nat Hist*, Ser 9, vol 3, pp 293 308, 1919) he showed that these two species could be separated by a number of characters—size, shape, colour, tarsal claws, width of ædeagus—but that intermediates could be found which formed an unbroken series connecting the two by insensible gradations His recent paper discusses the distribution, which is of great interest In southern England, *D elegans* only occurs, in northern England and southern Scotland, both species are found, with all grades of intermediates, in northern Scotland and throughout Ireland, only *D depressus* and intermediates approximating to the *D depressus* type occur

In 1927 Georg Ochs (*Koleopt Rundschau*, Bd 13, pp 34 36) directed attention to the whirligig beetles known as *Gyrinus natator* L, and showed that two forms, separable by size, colour, shape, punctuation, and slight differences in the ædeagus, were confused under this name The true *G natator* L is found in the north eastern palæarctic region, while the other form, *G substriatus* Stephens, occurs in south west Europe At the extremes of their range both forms occur without admixture, while in northern Europe both can be found side by side The common British form is *G substriatus*, and D Sharp, who examined very large numbers, appears to have met with no other I have recently found a dark form occurring in Cambridgeshire and Scotland, which I described as *G natator* var *fowleri* (*Ent Mon Mag*, vol 66, p 74 1930) Since then, through the kindness of F H Day and H Britten, I have examined specimens of the true *G natator* L from Cumberland My specimens of *G natator* var *fowleri* form an almost perfect series connecting *G natator* L and *G substriatus* Steph

It therefore appears that we possess in *G natator substriatus* a species pair almost exactly paralleling the *D depressus elegans* pair so beautifully worked out by Balfour Browne This seems unlikely to be mere coincidence, particularly as both the northern species are characterised by melanism and pure races of the southern species occur in southern England It may be that other similar pairs exist in other groups No doubt a proper study of such species will go far towards a solution of some aspects of that difficult matter the 'species problem', and throw new light on the process of evolution, here apparently in actual progress I would therefore be glad to have further information and also material of *Gyrinus*, preferably in alcohol, from different localities, particularly Scottish, Irish, and Continental JOSEPH OMER COOPER

Armstrong College,
Newcastle upon Tyne, Jan 22

Curling

I HAVE read with considerable interest the letter on curling by W H Macaulay and Brig General G E Smith in NATURE of Jan 10, in which they attribute the final twist of the curling stone to regelation But surely the time has come when regelation in this connexion should be relegated to the place of a laboratory myth, and might almost disappear from elementary text books In 1921 the late Sir George Beilby produced his famous book on "Aggregation and Flow of Solids" (Macmillan and Co, Ltd) and showed that these familiar ice problems can only be explained on the theory of surface and mass flow

It is doubtful whether a really heavy man, even if he were standing on one skate only, could exert sufficient pressure to raise the temperature of the ice to anything like the amount required by the theory of regelation, while a curling stone weighs only a few pounds and presents, relative to a man on one skate, a very large surface to the ice

In curling, one is dealing with a large number of factors, but it is more or less possible to single out three which are of primary importance

The first consists of the direction of mass flow of the ice On a really cold morning, and in the absence of sun and on a carefully flooded rink, this should be more or less constant Anything like a rise in temperature caused by bright sunlight will upset the conditions considerably, and hence the interesting but somewhat disconcerting variability of the ice as the sun rises over the hills and throws its welcome rays on those who are curling, about eleven o'clock in the morning during the winter sports season in Switzerland

In the actual curling there are two main forces acting on the stone in addition to gravity These are, of course, the initial forward motion of the stone and the twist or *handle* Both of these are inducing surface flow on the ice, and the actual direction of the stone is the resultant of these two forces, one or both of which may be opposed or reinforced by the direction of mass flow of the ice and hence the very intricate nature of the problem It is easy to see that if the direction of mass flow of the ice is the opposite to that of the initial direction of the stone, as the stone slows down a considerable amount of rotation may occur, and the stone may even remain stationary but rotating

Beilby showed that the normal surface of the ice, or that due to mass flow, is entirely different from the *vitreous* surface due to surface flow, the ice composing the surface of the one being stable in the absence of friction, while the ice composing the vitreous film is only stable at temperatures far below the normal melting point of ice The conditions on the typical curling rink in Switzerland are such that the transitions of surface flow to mass flow are very rapid and, in some cases almost instantaneous

That the problem is essentially one of the resultant of mass flow and surface flow is strongly borne out by the effect of sweeping Anyone who has been on the curling rink must have noticed the almost astounding effect that can be produced by good sweeping The real effect of an expert sweeper is to induce a strong surface flow and hence a vitreous film immediately in front of the stone hence the velocity of the stone is maintained and it does not curl

A G LOWNDES

Marlborough College,
Wilts

Biology in Education and Human Life

IN my Henry Sidgwick Memorial Lecture (NATURE, Jan 3, 1931) I protested that 'those should be regarded as lacking education who are altogether ignorant of the nature of living things' (p 21) Mr A D Ritchie has directed my attention to a sentence of Robert Boyle's, who about two and a half centuries ago, in much more beautiful words than mine, urged similarly that it is "highly dishonourable for a reasonable soul to live in so divinely built a mansion as the body she resides in altogether unacquainted with the exquisite structure of it" A V HILL

University College,
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Jan 23

The Monds and Chemical Industry a Study in Heredity.

"I propose to present his character and story with this object to cite him as the great example of those who do mightily yet cannot see what they are doing and who stand on the edge of doom with no vision of its approach"
—*Wolsey* HILAIRE BELLOC

"IN this world, one is too frequently approved or disapproved without being understood" This remark is passed by the Japanese professor of art, Yukio Yashiro, in the preface to the new edition of his opulent work on "Sandro Boticelli", in discussing criticisms aimed at his book Is it possible to understand any complex personality to the point of being able to "approve" his actions, by analysing them to their origin? Prove, German *prüfen*, is a very difficult verb to apply, at least in English, in German, it is without ambiguity

Some day, perhaps, biography will be written almost in terms of structural chemistry and the doctrine of descent stated in terms of the permutations and combinations effected between genes then, types, structural units, will be dissected out It is fast becoming clear that even the most complex of natural molecular units are but repetitionals that they are built up of simple parts frequently repeated The candle is a fit emblem of its substance as it may be made of any length, burnt to any shortness, to the mind's eye, it is the like of the Roman *Fasces*, in contexture When, at last, we see ourselves as chemists shall see us, the most wonderful imprint of pattern will be displayed upon our skins Maybe the analysis will not be possible before 'Jeansery' is at its last gasp and we are about to dissolve into radiation Still, suspicions of structure are already held by some of us

I merely wish to claim, in all modesty, that biography should be the recognised province of the structural chemist he alone can appreciate the complete interdependence of character and structure The supreme interest of chemistry comes from the fact, that it is the study of character as affected by structure Our senses seem to be but distortions of structure and electrical ripples—purely physical 'emotions' Witness the Poulsen phonograph, in which a steel tape is drawn across the magnetic field of the telephone returning the tape against the way it came, we have speech reproduced The tape hears and remembers what it hears, can tell what it has heard it all but lives! It is so human that it also forgets We cannot doubt that the molecules of the metal are displaced when magnetically spoken at, that they remember by retaining the new positions imparted to them, that speech is the molecular click as they revert to their original positions Seeing that 'wireless' can hit us as it does, there is no difficulty in understanding that we cannot but respond to every impression from outside

We need to be far more observant of hereditary character The Mond family seems to me to be specially deserving of study in this connexion Seldom has the biographer had the opportunity I have had of observing both father and son throughout their whole career of public activity I first met Ludwig Mond when his son Alfred was only three or four years old, in the early 'seventies. The parents were cousins, their two sons, Robert and Alfred, have always seemed to me to be near hybrids but with a clear bias from the mother The father was a man of very strong and determined character, almost rough originally, the mother, a woman of peculiar sweetness and sanity of outlook

Alfred Mond was born when a touch of sulphur was still lingering in the air, under a just ascending star, a true nova of the first magnitude in industrial progress Growing up in an environment of strongly alkaline pH he was to develop throughout the p gamut, ever progressing, first as politician of changing hue, from a radical bright red to a mild conservative blue, then as 'company combiner', until at last he became not merely leader as an industrial magnate but an industrial statesman—the first of his kind No more interesting man has trodden the stage of public life during his period In heredity and environment, he was subject to exceptional influences probably he had no peer, at least in his later days, when again the p's come in He was a peculiar being, maybe the forerunner of a new type the politician with intelligence, fully alive to the value and use of knowledge, even in the affairs of government as far from the demagogue as he possibly could be hence possibly the antagonism between him and Mr Lloyd George let us hope the last representative of an expiring crude and unscientific civilisation

Ludwig Mond, his father, came to England fully prepared, both by German education and Dutch experience of the alkali trade, for the work he undertook—aflame with the pioneering spirit and full of masterful energy He brought with him a process for the recovery of sulphur from alkali waste, then a nuisance as well as a by product This did not carry him far Hearing of Ernest Solvay's invention of an improved and novel process of making soda from salt, without sulphuric acid, he went over to Belgium and was just in advance of another claimant, Walter Weldon, in securing the English rights to work the invention As Mrs Mond told me more than once, he was ambitious, even in those early days, to play the part of the constructive pioneer, to be original, not merely to make money Originality, we have been told, consists in thinking for yourself, not merely in being different from others Ludwig Mond, in this respect, was most original He also knew his own limitations—that 'business' was not his forte so he sought out the ablest business man within his reach and found him in (Sir) John Brunner They were a perfect pair—one looked after the pounds in the works, the other after the pence in the office Mond secured a mere sketch from Solvay a vast amount of detailed work was necessary to bring the process to perfection it was full of difficult engineering minutiæ Taking off his coat, spanner in hand, he himself tightened up each bolt until the last leak of ammonia was overcome The ammonia-soda process was thus

quickly established, almost in its full perfection Mond was soon seen to be a destroying angel on Tyneside as the firm rapidly came to the fore The old Le Blanc process was mainly kept alive for its by-products

Ludwig Mond left Germany years before the time when the laboratory became a fashionable and necessary adjunct to the works—the source of advance, not merely a control station He also never followed the German system of giving members of the staff an interest in improvements or discoveries they might make Perhaps on this account the works remained an ammonia-soda works Still, his own mind was at work, seeking fresh fields to conquer Thinking in terms of ammonia, he was led, in the middle 'eighties, to take up the gasification of coal, largely with the object of recovering its nitrogen as ammonia He established large works at Dudley Port, from which producer-gas was supplied to the surrounding district The enterprise has not been the economic success that was expected, the more as conditions have changed to its disfavour—especially, of late, owing to the rise in the price of coal and the introduction of synthetic ammonia, which has much lowered the value of scrubbed ammonia It is strange how little success has attended all tampering with coal—except at the hands of the gas companies, who have known how to roast it hard all low temperature attempts have been economic failures and probably will remain so, at least until effective means of cleaning coal from dirt be devised Still, Mond's experiment has been of remarkable interest in many ways, as it has involved producing and carrying vast quantities of gas long distances at controlled rates, without use of holders The control secured is altogether surprising, on account of the scale of working Also, a hive of 'small industries' has been established

Had not Mond made what to me always seemed to be a blunder by burning coal to a *weak* gas, thinking its nitrogen to be of sufficient economic value to be worth recovery, although this involved the sacrifice of the tar, I believe he would have taken up the low temperature distillation of coal himself I had brought the subject before the Iron and Steel Institute in 1885 and had almost persuaded him to undertake an intensive study of coal, when suddenly he became over-excited by thoughts of ammonia Had he done so, he would have carried out the inquiry scientifically and thoroughly thirty years ago, probably, we should have known where we were, and the public would never have been gulled into believing in the commercial possibility of oil from our coal Undoubtedly, a vein of idealism now began to be apparent in him He had little real feeling for coal as a substance, not being an organic chemist, nor had he specially directed his attention to fuel problems, although ever mindful of the need of preventing waste of energy Probably, he went out of his depth

At this time Mond's ever active mind embarked on a fresh quest Mindful of the great loss of energy involved in the use of solid fuel, he sought to develop the Grove hydrogen-oxygen, sulphuric acid, platinum, gas cell again perhaps a stroke of idealism For this purpose, he needed hydrogen in large quantity The only economic source was 'water-gas', the mixture of hydrogen and carbonic oxide produced by passing steam over heated carbon (anthracite) It was necessary to remove the carbonic oxide, a virulent poison to platinum He used a known method, which involved passing the mixture of gases over heated nickel In experiments carried out in his laboratory, in St John's Wood, his assistant, Dr Quincke, to prevent the passage of the poisonous carbonic oxide into the air, put the end of the escape tube from the apparatus into the air hole at the base of a Bunsen burner He noticed that the gas burnt with a smoky flame—evidently there was some volatile product Mond not only at once followed up this indication to the quick discovery of nickel carbonyl, $Ni(CO)_4$ finding this was easily resolved into nickel and carbonic oxide by heat, he forthwith developed a continuous reversible process for the manufacture of nickel on the large scale He was greatly assisted by Dr Langer, one of Victor Meyer's most able pupils The achievement is without precedent in the history of scientific manufacturing enterprise, in virtue of its originality, the rapidity with which it was conceived and the intrepidity with which it was executed

Ludwig Mond, therefore, was the founder of at least three industrial enterprises—two of them are great and highly successful and likely to be permanent He knew his subject he had practical chemistry in his bones, if ever man had Ever a thinker and worker, a man of action, never a man of words—he wrote no letters apart from business —he was highly cultured a good linguist, an art patron, himself a good judge From boyhood up, Mrs Mond had led him in literature and art She was an idealist of the first water, saturated with Goethe Their daily life was perfect

The son's career was very different He had not the advantage of a serious German education At school and university, he will not have been overtaught he was never spurred to special effort, as his father was, in order to make his way From an early age, brought up in a specially cultured society, using his own great innate ability, he himself became a man of considerable culture He read law but never entered into practice So far as I know, he had merely gathered impressions of natural science and had no affinities to it, differing in this respect from his elder brother, who has considerable knowledge of physical science and experimental proclivities

The son of parents situated as his were had no cause to exert himself He gradually became the politician, perhaps, too strong a radical to please his father Here probably he was greatly influenced by the late Sir John Brunner, an ardent politician In the House of Commons, a speaker of weight, he was so clear-headed, so well informed, so obviously a thinker of unusual breadth and sanity, that he soon acquired distinction In political office, he showed real administrative ability That he had a scientific mind was shown by his gradual

change in political outlook and his change of party. Of course, for party purposes, a man must resist the influence of intelligence and stick to his party; but it is only from this point of view that change of party is to be deprecated; actually, it is proof of strength and individuality—in no way discreditable.

In a measure, his translation to the Upper House, in 1928, probably in no way satisfied his ambition and was a disappointment, marking as it did the close of his political career. He had aspired to the highest office, beyond doubt, but pronounced idiosyncrasies of manner were against him: he was outwardly 'too foreign' to be acceptable. To satisfy his aspiration, in his later years, he devoted himself to industrial rather than to political statesmanship. The spirit of idealism, which I have spoken of as actuating the father, became greatly operative in the son. He showed himself to be gifted with a co-ordinating mind, whilst his father had been constructive. He entered into a discussion of the problems of labour and in the interests of 'rationalisation'—to use the fashionable word of the day—effected two great industrial combines. Whatever assistance he may have had, there is no doubt that his was the guiding spirit, his the driving force. To come back to chemistry, while the father was a true chemist, a highly original worker, who really made things, the son was like the modern physical chemist, who is more or less a visionary and a speculator in other people's works, not a worker himself. Apparently, the one cannot be the other. Some of us contend that the physical chemist does not know enough chemistry to justify the certainty of his opinions. It is a question whether Alfred Mond knew enough to deal with issues and problems of the complexity and magnitude of those he undertook. Although scientific in his outlook, a systematic user of knowledge, he knew nothing of experimental and physical science and cannot have had any real feeling for the industries with which he was connected.

In effigy to-day he commands an Imperial position in Chemical Industries—his father on his right hand. By a strange turn in the wheel of fortune, he was led to develop, on a colossal scale, the manufacture of ammonia from atmospheric nitrogen by the Haber Bosch process, so taking a step commercially antagonistic to his father's perhaps most favoured enterprise: ruinous also to the Chile nitrate industry. It may be that one good turn deserves another: industrial progress, so-called, too often seems to involve the supercession of earlier workers. The grave economic, political issue of the present universal industrial rush to our atmosphere, however, has yet to be apparent. To make the inert active is always dangerous, if not an impiety; it may well be a jump from frying-pan into a burning fiery furnace of soil destruction.

Father and son probably could never have exchanged places: they were different natures. Ludwig Mond kept pretty well within the limits of his abilities and sought competent assistance when going outside them: to decide to what extent the son was Napoleonic and overstepped his, will not be easy. One thing is certain, that like his father before him, he gave his full strength to whatever service he undertook. Opinions greatly differ as to the wisdom of his action—as to the competency of a system such as he sought to develop. On account of the growing gravity of the industrial situation, the absolute need of completely scientific management—in other words, of complete understanding—a full inquiry into the problem of control should be undertaken with all possible care and without delay. The matter is already engaging attention abroad and such discussion is therefore of immediate national importance to us. It cannot be undertaken by men of affairs alone—they have not the necessary breadth of knowledge.

Much is said of academic research as the mainstay of industry and industry is being called upon to give support to the work. At the moment, there is great waste of energy and of funds, both national and private, on account of lack of co-ordination and clear cut views as to the purpose of the work—particularly because of the lack of competent supervision. The great need in industry of full inquiry into the efficiency of the methods followed in its own management and conduct has yet to be recognised: in such direction, industrial research is imperative.

HENRY E. ARMSTRONG.

Southern Whales and Whaling.

THE Discovery Committee appointed in 1923 as a result of the findings of the Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands is now issuing, under the general heading of "Discovery Reports",* a series of reports by the Committee's scientific staff and others on the investigations being carried out in the southern hemisphere—mainly regarding the scientific aspect of whales and the whaling industry. As in other recent expeditions, the reports are not published in any definite sequence of subject, but as the different stages of the work are completed. The advantages of this procedure are obvious.

The principal industry of the Falkland Islands is whaling, and, since the inception of commercial operations in 1904, there has been a rapid rise in the success of the industry. The history of whaling operations in other parts of the world has acted as a powerful stimulant, both to the administrative controllers of the Dependencies and to scientific experts, to gauge the effects of excessive slaughtering of

* Discovery Reports, Vol. 1: Station List, 1925–27. Pp. 140 + plates 1–6. 14s. net. Discovery Investigations: Objects, Equipment and Methods. Part 1: The Objects of the Investigations, by Dr. Stanley Kemp; Part 2: The Ships, their Equipment and the Methods used in Research, by Dr. Stanley Kemp and A. C. Hardy; Part 3: The Marine Biological Station, by N. A. Mackintosh. Pp. 141–232 + plates 7–18. 9s. 6d. net. The Natural History of the Elephant Seal, with Notes on other Seals found at South Georgia. By L. Harrison Matthews. Pp. 233–256 + plates 19–24. 4s. net. Southern Blue and Fin Whales. By N. A. Mackintosh and J. F. G. Wheeler; with two appendices by A. J. Clowes. Pp. 257–540 + plates 25–44. 30s. net. Parasitic Nematoda and Acanthocephala collected in 1925–27. By Dr. H. A. Baylis. Pp. 541–560. 2s. net. The Birds of South Georgia. By L. Harrison Matthews. Pp. 561–592 + plates 45–56. 12s. net. (Cambridge: At the University Press, 1929.)

whales and, if necessary, to devise a system of regulation to maintain the stock It is not feared that the whales will be actually exterminated—because the industry must fail long before the whales are reduced to the point of extinction—but that the industry will collapse and the valuable supply of oil will be lost Any restrictive legislation, whether national or international, must be based on the findings of scientific research The prevention of waste at shore stations under the jurisdiction of the Government is a matter of routine, but the protection of the stock of whales calls for more knowledge than the scanty data at command can supply It is, therefore, the object of these investigations to achieve more definite and increased knowledge of whales on which to base methods of conservation, and to Mr Darnley and Sir Sidney Harmer credit is largely due for laying the foundations of this whaling research

Vol 1, which was published during the early part of the past year, contains the results of part of the work undertaken by the staff during the years 1925–1927, and consists of six parts, with a foreword by Mr E R Darnley, chairman of the Committee The Station List which occupies the first part is more or less stereotyped, but the tabulation, opposite each station, of the hydrological observations, including hydrogen ion concentration, oxygen and phosphate contents of the sea water at different strata, is a distinct advantage

In the second part, the Director of Research, Dr Stanley Kemp, gives a brief outline of the aims and objects of the investigations, stating that " the main object of the work is to obtain further information on whales and on the factors which influence them " This entails studies of the whales themselves and of their environment Work at a shore station was considered essential and a marine laboratory was established at South Georgia, where the whales landed in the course of commercial operations were examined by the resident staff with the view of determining their specific identity and their relationship with similar types captured in other areas Concurrently with the collection of statistics for racial studies, investigations were undertaken on the anatomy of the whale to elucidate the fundamental points in the life history of the species As commercial whaling more or less ceases during the antarctic winter, the observations at the laboratory at South Georgia do not cover the full reproductive cycle, so that a transference of the staff during the southern winter was made to South African waters, where similar work was continued on the whales landed at Saldanha Bay The study of the environment of whales could only be attacked by observations at sea, and it was considered necessary to have two ships to cover the enormous area in which observations would have to be made to cope with profitable lines of research The *Discovery*, Capt Scott's famous ship, purchased and specially refitted, was commissioned in October 1925, as the larger ship, for the major part of the oceanographical work, while the smaller *William Scoresby*, built on the lines of a whale catcher, was designed for the pursuit of whales, with the primary object of shooting numbered discs into them in an attempt to get actual data as to their migrations. The general programme of investigation follows very closely on the lines adopted for the study of commercial food fishes by the International Council for the Exploration of Northern Seas

In the same report, the equipment of the ships is discussed by Dr Kemp and Mr (now Prof) A C Hardy The structural alterations in the *Discovery* and the fittings for the working of the most modern scientific apparatus are described in detail (see also NATURE, June 20, 1925, p 950) There are numerous diagrams and photographs illustrating the various points The *William Scoresby* was built to the specifications of the Committee on the lines of a whale-catcher and was further adapted for commercial trawling Apparently she has turned out to be very efficient as a sea going ship and trawler but only moderately successful, so far as the experiments have gone, for shooting numbered discs into live whales—probably because of the ship's larger size, slower handling, and increased noise in comparison with the usual whale catcher The type of mark, however, its size, and the method of shooting, from a rifle which is effective only at a very short range, seem to affect the success of the operations Several methods of marking have been and are being tried, mostly by Norwegians, but there appears to have been a lack of success in all of them The problem is most difficult and its solution is absolutely essential for the success of the investigations, but no doubt every effort is being made to obtain successful results In the same report the construction and fittings of the shore laboratory at Grytviken, South Georgia, are described by N A Mackintosh, who was in charge of this station Here the methods employed for counteracting intense cold and high winds form an interesting adjunct

A further part is devoted to the seals of South Georgia and is by L H Matthews Attention is directed chiefly to a study of the natural history of the elephant seal, which has been the object of pursuit for about two centuries on account of its valuable commercial properties, and has undergone considerable fluctuations in abundance of the stock The elephant seal is polygamous, as shown conclusively, if such proof were needed, by the photograph of a harem taken purposely during the *Endurance* Expedition in November 1914 and reproduced in this publication Apart from this factor, which supports scientific selection in slaughtering, the sealing industry has been under efficient Government legislation since 1910, when special sanctuaries were set aside for the preservation of the species Since the beginning of the century the southern fur seal has been observed on rare occasions in the Dependencies of the Falkland Islands, and the problem of re establishing the species in these subantarctic islands, with the view of scientific farming on the lines of the successful experiments by the United States Government at the Pribylof Islands, has been receiving attention

The section by Messrs Mackintosh and Wheeler, on southern blue and fin whales, with appendices by Mr Clowes, is a compendious report which

occupies about half the volume and is the result of the work on the whales landed from 1925 to 1927 at the shore stations—Grytviken, in South Georgia, and Saldanha Bay, South Africa A considerable part of it is taken up with descriptions of the external characters of these two species and with tables of measurements of body proportions, with the view of establishing the specific characters of southern whales and to define the limits of variation This is an essential part of the investigations, as information on the specific, sub specific, or racial relationships with similar whales in other areas is of fundamental and far-reaching importance From the treatment of their data, the authors are convinced that there are close resemblances between the whales of South Georgia and South Africa, and that there are no definite grounds for sub specific or racial distinctions Comparison between the whales of the northern and southern hemispheres has not so far been attempted, at least on a large scale, but the data which are still being collected will, no doubt, be utilised for fuller statistical treatment in the near future

Examination of the stomach contents formed a routine part of the programme The results were interesting, in so much as all the whales (excluding the sperm) were found to be feeding on Crustacea—and chiefly, if not exclusively, on Euphausiæ, *E superba* at South Georgia and *E recurva* at South Africa This is an interesting and important point, which no doubt will be supplemented by observations from other southern areas So far as the fin whale is concerned, this species in the northern hemisphere is known to be a mixed feeder and to subsist largely on fish, but it is considered to be solely a plankton feeder in the south

Routine measurements of the thickness of blubber were also made with the view of establishing any seasonal increase or decrease and specifying its relation to the food supply Thickness of blubber has a definite bearing on oil production, but, apart from seasonal variations, information is desired on other points, such as thickness in proportion to length of whale, involving a study of physical maturity, and in females, the conditions during pregnancy and lactation In pregnant females the blubber is abnormally thick, but in whales generally there is a relative increase in thickness of the blubber with increasing whale length Whales as a rule were found to be fatter at the end of the South Georgia season, while the thickness decreased in South African waters

The anatomy and physiology of the reproductive organs have formed an integral part of the researches, and much good fundamental work has been done on the ovaries, mammary glands, and testes The evidence available from these observations has been used in the interpretation of the breeding habits and growth of whales, but information from other sources, such as the occurrence of fœtuses, the seasonal movements and habits of whales, has been utilised in piecing together the life history and reproductive cycle. The conclusions drawn from the investigations rest ultimately on breeding and feeding migrations, which in the present state of our knowledge are more or less assumed from circumstantial evidence to be north and south, but these deductions would be enormously enhanced in value if supported by direct evidence through the capture of even a few marked whales

Apart from this apparent weakness, which is largely due to the nature of the work on whales caught commercially, the authors have made good use of the data at their command and have given an acceptable estimate of several fundamental points on which accurate diagnoses are essential Thus, they have defined the mean length of sexual maturity for—

Blue Whales,	Female,	at 23 7	metres	(77 ft 9 in)	
,,	Male,	,, 22 6	,,	(74 ,, 2 ,,)	
Fin ,,	Female,	,, 20 0	,,	(65 ,, 7 ,,)	
,, ,,	Male,	,, 19 5	,,	(63 ,, 8 ,,)	

The pairing season takes place principally from May to August, with a maximum in June to July for both these species, but, as stated, the results indicate, at least for the fin whale, a protracted period over seven or eight months The authors are convinced that whales are polyœstrous, and that if impregnation be missed during any period of ripening of an ovum, there are traces of this occurrence in the ovaries as corpora lutea of ‘ ovulation ’ The frequency of this feature is unknown, but it does not strengthen claims to a breeding concentration and complicates the estimation of age by reading of the number of old ovarian scars The length of the period of gestation has been estimated at a little more than ten months for blue whales and eleven and a half months for fin whales, with possible variations according to the time of impregnation This conclusion has been drawn largely from an examination of the fœtuses obtained during the investigations and from the records of the smallest calves, which latter were extremely few From the same evidence the season of parturition was defined and the period of birth of the calves was stated as mostly April and May for blue whales and June and July for fin whales The accuracy of the determinations, however, depends largely on the question of the representative nature of the material examined

The length at birth has also been estimated in a general way and probable estimates have been given as 7 0 metres (23 ft) for blue whales and 6 5 m (21 ft 3 in) for fin whales The average length at which weaning takes place has been more difficult to determine, as the data on which the estimate has been made are rather scanty, but the rate of growth of the calf during the nursing period has been approximated with the help of data supplied to the British Museum by the whaling companies at South Georgia and at South Africa The duration of the nursing period has been put at about seven months for blue whales, and for the fin whales, on slightly less representative material, at six months During this period the astonishing result has emerged that the blue whale calf more than doubles its length, while the rate of growth of the fin whale calf is also rapid but not quite so considerable The subsequent growth of the adolescent whale to sexual maturity again rests a good deal on conjecture, but

there seems sufficient justification for the authors' interpretation of the available statistics that sexual maturity is reached at the end of the second year, at lengths already stated for each species No definite method for determining the age of whales, beyond the early stages, has emerged, though various studies have been made in this direction, but these have not advanced beyond the stage of fixing that the whale is either an old or a young one, for example, by the number of old scars on the skin, the condition of the vertebral epiphyses, and the number of old corpora lutea

The application of the results obtained to economic conditions is discussed at some length, but as this necessitates a thorough understanding of the whole stock of whales, the question will have to be considered from all points of view The arguments put forward by the authors refer to the particular areas in which the investigations were made, and rest largely on the assumption that there is little discrimination in the killing of the whales in any particular area, and that the nature and composition of the catches are likely to be fairly representative of the whale population The problem of fluctuations in the number and condition of whales requires a lengthy series of observations, but several interesting points are touched upon in the present report which, with a fuller knowledge, may prove to be of great importance Much is made of the concentration of whales in the area of the Falkland Islands, and some of the causes for this concentration are given considerable prominence, but there are a few million square miles of sea round the antarctic barrier still unexplored, and it may well be that other features will emerge which will call for intensive study In the history of whaling operations in the northern hemisphere, it has been impressed on us that the *locus operandi* has shifted from one locality to another, and that in each case the killing off of the whales almost to extinction in any particular region has not been followed by a return to the region of the same type of whales in numbers sufficient to resuscitate the industry This is, meantime, an unexplainable point, but one that requires attention

The fifth part is a purely scientific report by Dr H A Baylis and deals with the first consignment of material belonging to the parasitic Nematoda and Acanthocephala collected from whales, seals, and fishes Five species of Nematoda and three of Acanthocephala are described as new to science These are interesting from the point of view of the distribution of their hosts

Another section by Mr L H Matthews is on the birds of South Georgia Thirty one species are listed as having been observed at the island both by himself and by previous observers The text is in the form of brief notes on the species, except in a few cases, for example, the Albatrosses, where the breeding habits are described from the writer's original observations In most cases a popular name is given to the species, but one misses familiar terms like Night Hawk for the Cape Hen, Paddy for the Sheathbill, Nellie for the Giant Petrel, and Johnny for the Gentoo Penguin Nineteen species were observed nesting, while other six are quoted from previous observers as breeding on the island Fregetta is recorded as being observed only by the Transit of Venus Expedition at Royal Bay, but the scientific members of the *Endurance* Expedition observed a pair of these birds at close range at Larsen Harbour in November 1914 The report opens with a curious mistake as to Shackleton's itinerary on the famous boat journey in April and May 1916 from Elephant Island, South Shetlands, erroneously stated here as South Orkneys, which, by the way, has also been overlooked in the list of corrigenda There are twelve plates (three in colour) attached to the report, and many of the figures are exceedingly good and most useful

The New Zealand Earthquake of Feb 3

By Dr C Davison

OUR knowledge of New Zealand earthquakes extends over little more than a hundred years Since 1814, when missionaries first landed in the islands, there have been four great earthquakes—in 1826, 1848, 1855, and 1929—but none of these, unless it be the earthquake of 1855, can be compared with the shock that on Feb 3 brought ruin to Napier and other towns in the North Island Certainly none has been so destructive of life On June 17, 1929, 17 persons were killed during the Murchison earthquake, in all previous earthquakes since 1848, not more than seven During the shock of last week, at least 140 lives were lost, and the number may be increased when the ruins of the larger buildings have been searched

The earthquake occurred at 10 48 A M and lasted for about two minutes The principal towns damaged are Napier and Hastings Napier lies on the shore of Hawke Bay, and the houses that suffered most are those in the business quarter, built for the most part on land reclaimed from the sea Hastings is an inland town about 12 miles south south-west of Napier The other places at which buildings are damaged or lives have been lost lie within or near a band about 45 miles long and 12 or 15 miles wide running south south west from Napier or parallel to the coast line to Waipukurau It is in the neighbourhood of Napier, however, that the material damage is greatest Railway lines there are buckled, roads are fissured, and many landslips have occurred, especially to the north of the town

The earthquake was recorded at Kew Observatory at 11 h 6 m 52 s, P M (G M T) on Feb 2, the amplitudes of the movements were about twice those caused by the earthquake of June 17, 1929, and the total duration of the disturbance was about four hours

One of the most interesting features of the earthquake is the rise of the land about Napier

The pool in the harbour known as the Iron Pot, where fishing boats and small steamers hitherto lay, is now dry land According to the report of the Governor-General, the bed of the harbour has been raised in places by 18 feet It seems clear that the rise of the land was not abrupt, for steamers left the harbour and proceeded to sea "on account of the anchorage shallowing rapidly"

For many years, slight earthquakes have been frequent in the Napier district In the list of New Zealand earthquakes from 1848 to 1890 drawn up by the late Mr G Hogben, at least 27 earthquakes had their origins in this zone

Though the stronger earthquakes of New Zealand can scarcely be ranked with the greatest of some other lands, they have all been accompanied by notable displacements of the earth's crust In 1826, a cove in the South Island about 80 miles north of Dusky Bay was converted from a safe anchorage for sealing vessels into dry land The earthquakes of 1848 visited the northern part of the South Island A great rent was then formed in the mountain chain running south south west from Cloudy Bay, and was traced for a distance of 60 miles During the Wellington earthquake of 1855, a tract of land at the southern end of the North Island measuring 4600 square miles was uplifted from one to nine feet The fault along which the greatest movement occurred runs along the eastern flank of the Remutaka range, and the nearly vertical scarp was traced for a distance of about 90 miles Lastly, with the earthquake of 1929, which occurred in the north west portion of the South Island, the ground on the east side of the White Creek fault was shown, by the renewed levelling of the district, to have risen at one point by 16 ft 1 in

The investigation of the recent earthquake by the competent seismologists of New Zealand and the re levelling of its central area can scarcely fail to add greatly to our knowledge One of the most interesting points to be determined is the connexion of the earthquake with the fault or system of faults that was in action in 1855, for though 30 miles or more to the north north east of the end of the fault scarp of that year, the meizoseismal area seems to lie along, or not far from, its line of continuation

Obituary

Mr A B Basset, F R S

Alfred Barnard Basset was born on July 25, 1854 He was educated at Trinity College, Cambridge, and graduated in 1877 as 13th wrangler, a position which could scarcely have represented his real mathematical attainments He was called to the Bar at Lincoln's Inn in 1879, but not being under the necessity of adopting a profession, he soon abandoned the law, and, apart from the duties of his private station, devoted himself mainly to mathematical research

From 1883 onwards Basset produced a succession of papers on applied mathematics, mainly on subjects suggested by current discussions The 'classical' hydrodynamics had at that time a great fascination for a number of rising mathematicians, and Basset's own contributions in this kind to the *Proceedings* of the Cambridge Philosophical Society, the London Mathematical Society, and the *Philosophical Transactions* were of distinct merit Among the numerous subjects which he treated we may mention the equilibrium of revolving fluids, and the theorems of Dirichlet and Dedekind, the interest in which had been revived by Bryan, Greenhill, and Love At a later stage he attacked the theory of elastic plates and shells, which was then a matter of controversy, and was led to recognise independently the true explanation of a rather serious difficulty Mention should also be made of his work on viscosity, and in particular on Boussinesq's problem of the variable slow motion of a sphere in a viscous fluid These are only a few items out of the long list which appears in the Royal Society's catalogue

Basset's work was distinguished throughout by a remarkable command of analytical methods As an example, it may be noted that he was an expert in the use of Bessel functions, and discovered new results in this connexion, at a time when the theory was only beginning to be familiar to English applied mathematicians He was elected a fellow of the Royal Society in 1889, and was vice president of the Mathematical Society in 1892-93

Basset was also the author of several able treatises A work on hydrodynamics, in which he incorporated much of his original work, was published in 1888, and did much to promote the interest in the subject This was followed in 1892 by a treatise on physical optics, another of his favourite subjects, to which he devoted immense pains, but which scarcely met with the recognition which it undoubtedly deserved

At a later period, Basset turned his attention to pure mathematics, and produced two text-books, on cubic and quartic curves, and on solid geometry But his interest in scientific matters, and his relations with mathematical contemporaries, seem gradually to have faded, partly no doubt owing to failing health, and he lived in great retirement at his seat in Berkshire He died on Dec 5, at the age of seventy six years H L

Dr F M Turner

Dr F M Turner died unexpectedly on Jan 17 at the age of sixty-four years, after a surgical operation Educated at Cambridge and Guy's Hospital, he was for thirty-four years the loved and respected superintendent of the South-Eastern Fever Hospital at New Cross He was an acute student of infectious diseases, and published notable work on return cases of scarlet fever in 1906 and on the relation between vaccination and smallpox in *Biometrika* in 1906 and 1907

Dr Turner was a man of insatiable curiosity and had wide interests outside his immediate professional concerns, especially in fresh water biology and the keeping of aquaria, in which he had a happy

knack He read widely and always maintained a keen interest in fresh developments of biology He took a large part in the investigation of the inheritance of sinistrality in *Limnæa peregra* with Boycott, Diver, and Garstang, recently published in the *Phil Trans*, and incidentally made a number of valuable measurements of the factors which influence the rate of growth of water snails 'Semper's law' particularly attracted him, and he succeeded in showing fairly conclusively that the larger size of individuals reared in larger volumes of water is due to the greater supply of food He also made a number of original observations on the kinds of algæ actually eaten by snails, and of their preferences and dislikes for different species Some of his results are published in the *Naturalist* (p 231, 1926) and the *Essex Naturalist* (p 48, 1927), but many of his problems were waiting for the further experiments which he had planned to make when he retired this next summer

WE regret to announce the following deaths

Mr J D H Dickson, senior fellow of Peterhouse and author of numerous papers on thermodynamics and thermoelectricity, on Feb 6, aged eighty one years

Mr D T Jones, C B E, chairman of the Fishery Board for Scotland, on Feb 4, aged sixty five years

Dr C Krumwiede, professor of hygiene and bacteriology at New York University, assistant director of the research laboratory of the Health Department of New York and past president of the Society of American Bacteriologists, on Dec 28, aged fifty one years

Dr Albert Schammelhout, secretary of the International Pharmaceutical Federation and an honorary member of the Pharmaceutical Society of Great Britain, on Jan 20, aged sixty years

News and Views.

EARLY this year we had the pleasure of offering congratulations on behalf of scientific workers generally to Sir Ernest Rutherford on the barony conferred on him by H M the King, announced in the New Year's Honours List (NATURE, Jan 10, p 65) A further proof of the world wide recognition of his brilliant achievements is the award, which we are glad to announce, of the Echegaray Medal of the Royal Academy of Sciences of Madrid This medal was founded by the Academy in honour of Señor D José Echegaray, its president from 1901 until 1916, and is awarded triennially to any person, Spaniard or foreigner, who shall, in the opinion of the Academy, have distinguished himself to an eminent degree in one or other of the branches of science for the promotion of which the Academy exists Previous recipients of the medal are Señor José Echegaray (1907), Señor Eduardo Saavedra (1910), Prince Albert I of Monaco (1913), Señor Leonardo Torres Quevedo (1916), Prof Svante Arrhenius (1919), Prof Santiago Ramón y Cajal (1922)

ON Feb 15 occurs the centenary of the death of the famous mechanician and engineer, Henry Maudslay, who was not only the founder of one of the most historic engineering firms of London but also was the originator of important advances in machine tools and engine construction He was the first to construct screw cutting lathes in which the slide rest is moved along the bed by means of a leading screw driven by change wheels, and it was from his interchangeable system of screw threads that Whitworth afterwards developed the well known Whitworth system Born in Woolwich in 1771, the son of a soldier who had become a carpenter in Woolwich Arsenal, Maudslay began work in the Arsenal at twelve years of age and by eighteen had acquired such extraordinary mechanical skill that Bramah employed him on the construction of his locks Later on, at the age of twenty six, Maudslay set up in business for himself in Wells Street, and in 1810 founded the works in the Westminster Bridge Road where, for nearly a century, marine engines were constructed for the Navy He was the maker of the famous block making machinery devised by Brunel for Portsmouth Dockyard And among his workmen were Clements, who afterwards constructed Babbage's calculating machine, Nasmyth, the inventor of the steam hammer, and Whitworth Into all his work, Maudslay introduced mathematical accuracy, while his constructions were all known for their beauty of proportion The business he founded was carried on until 1905 On his death, Maudslay, at his own desire, was buried in Woolwich churchyard, where a monument recalls his merits as an engineer and a man

THE Royal Commission on Transport, in its final report on the co ordination and development of transport in Great Britain (see also p 225), considers that of the two main causes of the present difficulties of railways, the long continued depression in trade, especially in the 'heavy' industries, is the more important, though road competition will be a more permanent adverse factor To meet such competition, a thorough overhauling of railway schedules, with speeding up of services and improved conveniences, including the removal of irritating conditions, revision of fares, and increased seating accommodation on main line trains, are recommended In regard to grouping under the Railways Act, the report recommends that each company should confine its attention to the needs of its particular area, that joint lines should be merged and the traffic pooled at points served by two or more railways Electrification of all suburban services where there is intensive passenger traffic, the closing of little used and unremunerative branch lines, and progress in the use of larger waggons and of containers are other recommendations In regard to road transport, expenditure on by pass roads but not on new arterial roads is recommended, and the activities of the Ministry of Transport should be concentrated on the complete reconstruction of many existing roads, the widening of roads, improvement of road junctions and lines of sight, strengthening of weak bridges, freeing of toll roads and bridges, and the progressive reconstruction of built up areas

THE members of the Royal Commission on Transport are satisfied that users of motor vehicles are in general fairly taxed, but that the ratepayers' burden in respect of roads is too great, they recommend that no proceeds of taxation from motor vehicles should be diverted from the Road Fund, but that the present proportion between ratepayers and motorist should be reversed The diversion of heavy goods traffic from the railways to the roads should be discouraged, steel tyres abolished, and pneumatic tyres used on all motor vehicles The report recommends that no additional tramways should be constructed, and, without laying down a definite time limit, that they should gradually be replaced by other forms of transport Certain canals are considered as still possessing real value as a means of transport, but they require rationalisation and development, although there is no territory where the construction of a new canal would be regarded as a serious proposition A number of the smaller ports have been allowed to fall into a state of decay, and the first step to be taken towards assisting coastwise shipping is the improvement of the ports used by coasting vessels In future road construction programmes, the requirements of harbour areas should receive a prominent place The Commissioners are of the opinion that, in principle, it is undesirable that one form of transport should own docks and harbours to which access by other means of transport is required A public trust is considered the best kind of authority to own docks and harbours, although transfer of the majority of railway owned docks and harbours is not recommended In regard to co ordination, the appointment of a small permanent advisory council on transport, to study transport problems both generally and in particular areas, and to advise the Ministry on action which might be usefully taken to promote the co ordination, improvement, and development of transport generally, is the only recommendation made, although the future of co ordination is discussed

THE debate on the second reading in the House of Commons of the Representation of the People (No 2) Bill took place on Feb 3 Several points in connexion with university representation in parliament were discussed during the debate Statistics were quoted by Sir J Withers, who stated that of the 12,000 university voters (NATURE, Jan 31, p 183), 10 per cent are living abroad, not, as has been suggested, as pleasure seekers, but as tea planters, consuls, Civil servants, and men of business He considered their votes of great value, especially where foreign policy is concerned He protested strongly against the proposed abolition of the university vote, on the grounds that the proposal was the result of a cynical bargain for party advantages, to get rid of Conservative members of the House, rather than a consideration of the public interest Miss Rathbone pointed out the value of such representation, in that special channels were thus supplied through which mental training could express its views Sir Graham Little stated that the reason for the removal of the twelve members had been quite frankly shown by Mr Clynes, when he said that those members were mainly Conservatives

IN defence of the Bill, especially the question of the abolition of university votes, Mr Ramsay Macdonald said that, at the present time, university representation is simply plural voting If any institution in the country requires special representation, it certainly is not the universities The universities pervade the whole atmosphere of the House, they are represented in every party and on every bench, because of the culture and enlightenment which the universities have spread among all classes of society On Feb 2, during the motion for the second reading, Mr Clynes said that whatever else university members may have exhibited, they have shown in the quality of their work in the House of Commons a lack of knowledge of public needs Mr Shaw, during the debate, expressed the view that university graduates should be content with the influence which their university training can give them in the community, without asking for a separate parliamentary vote At the division, 295 voted for the second reading and 230 against, giving a Government majority of 65

THE general secretary, Prof C Marie, of the committee for the publication of the "Annual Tables of Constants and Numerical Data (Chemical, Physical, Biological and Technological)", informs us that Dr M Volmer, professor of physical chemistry and electrochemistry at the Technische Hochschule in Berlin, has been elected a member of the permanent committee, and Prof M Bodenstein as honorary member of this same committee Prof W A Roth, editor of "Landolt Börnstein Tables", has agreed to participate in the editing of the thermo chemistry sections of the forthcoming volumes These nominations of German representatives are greeted with particular satisfaction, as they put an end to a situation for which events alone were responsible, but which were no less regrettable from a scientific point of view

ACCORDING to the tenth annual report of the British Electrical and Allied Industries' Association (E R A), being presented at the annual general meeting on Feb 13, the Association's income seems to be assured, and will, it is hoped, soon reach £50,000 a year. The work has recently been reorganised so as to secure that research is undertaken for the benefit of the industry as a whole and not merely for particular sections of it Provision has now been made to wind up all 'confidential researches' at the end of the year, the rights of interested sections in certain confidential work being safeguarded Some of the work done is mainly of technical interest, but some of the reports disclose phenomena which are of a more general interest At first sight a report of the effect of storage in a warm atmosphere on the properties of adhesive electrical insulating tapes seems purely technical; but it may well give rise to research of interest to physicists The research on the heating of cables buried deeply in the earth has led to important conclusions The experiments show that the thermal resistivity of the soil diminishes with the depth, and

hence cables carrying heavy currents can get rid of more of their heat than had been anticipated This tends to compensate for the greater distance from the earth's surface, and so the carrying power of deeply buried cables is not necessarily worse—and is indeed sometimes better—than that of cables buried only two or three feet below the surface This is generally due to the fact that the soil is more compressed at the greater depths The experiments show the necessity of studying closely the difficult problem of the movements of the moisture in the soil, under the influence of the thermal gradients due to the heating of the cables Methods have also been devised of improving the thermal conductivity in the neighbourhood of the buried cables

THE Hurter Memorial Lecture delivered by Prof G T Morgan before the Liverpool Section of the Society of Chemical Industry, on Jan 16, gave a survey of recent developments in organic syntheses through the use of pressure The original impetus in this field came in the production of intermediates for dyestuffs, and the experience thus gained by the great German firms was of fundamental importance in the development of the ammonia synthesis, and afterwards, following the study of the reactions between carbon monoxide and hydrogen at high temperatures and pressures in presence of catalysts in the manufacture of methyl alcohol Prof Morgan is still hopeful that the synthesis of ethyl alcohol and higher alcohols is possible, without a simultaneous loss of carbon monoxide, by complete reduction to methane Dealing with oxidation under pressure, the production of $\alpha\alpha'$ dipyrryl, with a bispyrrypyridine, which gives a remarkably stable ferrous co ordination compound with iron, from pyridine and anhydrous ferric chloride at 350° and about 50 atmospheres, was cited Reference was also made to studies on the Kolbe Schmidt reaction and on the action of carbon dioxide on phenols and on amines in the presence of anhydrous metallic chlorides, which are still yielding results of importance in the dyestuffs field Prof Morgan believes that a systematic study of high pressure reactions will lead to discoveries whereby the use of pressure may be partly or entirely avoided, and points out that, as the discovery of more effective catalysts lowers reaction temperature, high pressure synthesis should approximate more closely to the elaboration of complex carbon compounds, associated in Nature with the vital activities of plants and animals

AN interesting legislative experiment is apparently to be made in the United States Science Service reports that Congress has unanimously passed a law which gives to the man who produces new plants "the same encouragement and protection that the inventor of new mechanical or electrical apparatus has received for more than a century" New plants can be patented, and for seventeen years the breeder of a new plant will have a monopoly on its production It is added that, as yet, full procedure for handling plant patents has not been worked out When this has been done, possibly the authorities may discover some difficulties in the way of this new legislative project Plants propagated from seeds and from tubers are apparently excluded from its operation, but fruit trees, ornamental shrubs, etc, which can be vegetatively propagated come under its operation: it is not clear on what principle the tuber, a vegetative mode of propagation, should be excluded when other vegetatively propagated plants are included, but its exclusion may considerably reduce legal actions contesting patents under the new act It will be interesting to see how the breeder establishes his claim to a new plant under the law If he states that his new plant is the result of hybridisation between two named parents, how will this affect the operation of other breeders who desire to make the same cross? Will the same effect be ruled to follow, in law, if the same parents are used in the same manner upon another occasion?

AT Daytona Beach, on Feb 5, Capt Malcolm Campbell beat the world's land speed record, which was set up by the late Sir Henry Segrave at the same place on Mar 11, 1929 Major Segrave's average speed over the measured mile was worked out as 231 36226 miles per hour, and the new record achieved by Capt Campbell works out as 246 154 miles per hour Exceptional credit is due to Capt Campbell for his feat, since conditions were far from good Visibility left much to be desired and the course was found to be uneven in places, especially at the northern end These drawbacks did not deter him, however, and he set out, taking a flying start of 5 5 miles, which is 1 5 more than usual His car, the Napier Campbell *Blue Bird*, was fitted with a supercharged Napier aero engine, similar to those of the Supermarine seaplanes used in the Schneider Trophy contest in 1929 The engine develops more than 1400 horse power The speeds returned for Capt Campbell were southward run, 246 575 miles per hour, northward run, 245 733 miles per hour—or an average of 246 154 miles per hour

COTTON that has been grown entirely in England will be displayed in the Empire Marketing Board's stand at the British Cotton Textiles Exhibition which opens at the White City, London, on Feb 16 Less than 30 miles from London there are 'cotton fields' complete with plants which have flowered, fruited, and flourished for three generations Specimens of various types of cotton grown in glass houses at the Rothamsted Experimental Station will be shown alongside cotton from seven Empire countries The plants have been grown for the purpose of scientific study of 'black arm' disease, which attacks cotton in the Sudan, Nigeria, and Uganda It is due to a bacterium which causes the young plants to wilt and die, and in another form, 'angular leaf spot', attacks the leaves and prevents the plant from producing lint A grant has been made by the Empire Marketing Board for a study of the causes and spread of infection, and how 'black arm' may be checked Six tanks have been erected in which the temperature of the soil and the atmosphere, the humidity, and the amount of light can be controlled by those in charge The workings of these tanks—the only apparatus of its

kind in the country—are to be shown by means of an exhibit of photographs, and cultures of the disease will also be exhibited

In continuation of the series of special exhibitions to illustrate the resources of raw materials of the British Empire which have been given at the Imperial Institute, a special exhibition of the mineral resources of the Empire will be opened by Mr Amery on Feb 17 This exhibition, besides bringing out some facts which are little realised by the general public—for example, the vast wealth of minerals produced within the Empire as compared with the rest of the world—will also show the utilisation of some of the lesser known minerals, which are nevertheless of great importance Again it is not generally realised that 90 per cent of the world's nickel output, 90 per cent of the asbestos, and 72 5 per cent of the world's gold output were produced within the Empire in 1928 Sir Robert Horne will give an address on the mineral resources of the Empire in the cinema at the Imperial Institute at 5 30 P M on Thursday, Feb 19 The seating accommodation is limited, and those desirous of attending should communicate early with the Secretary Imperial Institute, London, S W 7 There will also be a special series of mining films shown in the cinema throughout the exhibition Entrance will be free In connexion with the exhibition, the Institute is publishing a handbook on the mineral resources of the British Empire

It is announced that a course of lectures on "The Application of Anthropology to Practical Affairs in Africa" will be given by the Rev Edwin Smith at the London School of Economics on Mar 9, 10 and 11 at 5 P M The manner in which the lecturer will deal with his subject, as outlined in the announcement, suggests a thoroughly practical handling of the question both in the interests of the future administrator and others concerned with native affairs and from the point of view of the scientific investigator Rapidly changing conditions among backward peoples must, sooner or later, bring the anthropologist face to face with the question of the best way to deal with his problems in the field Is his aim to be directed towards the elucidation of native institutions, in so far as it is possible to ascertain their original form, or is he to record them as they now are and register their function in changing conditions? If anthropology is to serve as an applied science, it may not appear that the matter is open to question This is, no doubt, one of the points which Mr Smith will discuss, and upon which his knowledge of African conditions entitles him to respectful hearing In his first lecture, he will consider if we are on the right lines, in view of the Government's declaration with reference to the value of anthropology In his second lecture, African family life and the regulation of the sex impulse will be considered as a type problem calling for sound knowledge as a basis of any action, and in the third, he will deal with the changing African, and consider whether what the African is becoming, rather than what the African was, is a necessary study if anthropology is to help in the solution of African problems

In an age when iron is produced in enormous quantities and when scrap iron is scarcely worth picking up, it is difficult to realise the conditions in the fourteenth century, when, as stated by Rogers, on a farm "the most formidable item of expenditure on the supply of necessary dead stock was the annual cost of iron" The value of iron then was probably well over £100 a ton in our money, and even in the latter half of the seventeenth century wrought iron was twice as dear as rolled lead Such are some of the statements given in the authoritative paper by Mr J W Hall on "The Making and Rolling of Iron" contained in the recently published vol 8 of the *Transactions* of the Newcomen Society Originally produced direct from ore in quantities of 7 lb at a time, 'manufactured iron' even 250 years ago was made in a finery not much bigger than a smith's fire One great difficulty was the limited supply of charcoal, and between 1720 and 1750 the make of bar iron in the whole of Great Britain was only 250 to 350 tons a week The principal steps in the history of iron making include the use of coke in the blast furnace, Cort's invention in 1784 of 'dry' puddling on a sand bottom in a reverberatory furnace, and Joseph Hall's improvement in 1839 when he lined his puddling furnace with a partially fusible oxide of iron, an improvement which completely established the reputation of South Staffordshire bar Brown's first chain cables for the Navy, costing 6d a lb, were made of this bar, and it is the chain cable trade which to-day provides the chief outlet for the same material In the working up of the iron, the trip hammer was used with great skill, and such hammers were used for iron long after rolling had been adopted for other metals Slitting mills were in use in England in 1590 Rolls for iron were first used merely for finishing to size, but Cort's patent of 1783 laid the foundation of the existing methods of rolling sections

A third international conference on bituminous coal will be held at the Carnegie Institute of Technology in Pittsburgh, Pa, in November next, again organised by Dr Thomas S Baker, president of the Institute of Technology Prominent fuel technologists from all parts of the world will be invited to attend the conference In connexion with the organisation of the meeting, Dr Baker has visited Europe to invite prominent scientific workers to speak at the congress The purpose of the conference will again be to present for discussion the results of recent studies in coal, and particularly the economics of the new methods and processes that are being evolved The programme will include papers on carbonisation, liquefaction, and gasification of coal; by-products of coal; the mechanism of combustion; cleaning of coal and its preparation for the market; pulverised fuels; power plants, and domestic heating The advisory board supporting Dr Baker includes J A Farrell, president of the United States Steel Corporation; J H Hammond, mining engineer; F B Jewett, president of the Bell Telephone Laboratories; A W Mellon, Secretary of the United States Treasury; F A Merrick, president of the

Westinghouse Electric and Manufacturing Company, A G Pratt, president of the Babcock and Wilcox Company, H B Rust, president of the Koppers Company, M S Sloan, president of the New York Edison Company, G Swope, president of the General Electric Company, and W C Teagle, president of the Standard Oil Company of New Jersey It is hoped that the conference will assist in discovering new processes and help the recovery of the coal industry

THE council of the Institution of Electrical Engineers has made the tenth award of the Faraday Medal to Mr Charles H Merz, a well known electric power and traction engineer The Faraday Medal is awarded by the council of the Institution, not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution

THE following appointments to the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies Mr H Wolfe, deputy director of agriculture, Tanganyika Territory, to be deputy director of agriculture (plant industry), Kenya, Mr N D Simpson, to be systematic botanist, Ceylon

THE Empire Marketing Board has approved a grant, for two years, for an investigation into the technique of milk examination by the London School of Hygiene and Tropical Medicine The present standards for the bacteriological grading of milk were established in 1923 It has since become clear that they are not sufficiently complete, and, in view of their great importance in securing a thoroughly reliable 'clean milk' supply, it has been decided to work out a new technique to be accepted as the official standard in all cases of litigation

WE regret that an error was made in our reference to the new catalogue of lantern slides issued by Messrs Flatters and Garnett (NATURE, Feb 7, p 211) Chief credit for this production was given to Mr Flatters We understand that Mr Flatters has not been in the business for many years, and that the compilation of the catalogue (especially the botanical section) was due mainly to Mr Henry Garnett

THE Wellcome Foundation, Ltd, is to erect a new medical and chemical research building at the corner of Gordon Street and Euston Road, London, W C 1, on the site, 225 feet by 135 feet, now partly occupied by its Bureau of Scientific Research For many years the Foundation has maintained medical and chemical research laboratories, but recent developments have made it necessary to co ordinate and extend these activities The new building will furnish the additional accommodation required, and be provided with the most modern research equipment The architect is Mr Septimus Warwick

THE 1932 meeting of the Iron and Steel Institute will be held in the United States of America, under the presidency of Colonel Sir Charles Wright, Bart. Joint arrangements, with reference to ocean and inland travel, are being made with the Institute of Metals, which is also holding a meeting in the United States in 1932 The inclusive dates for the meetings and excursions are Sept 12–Sept 29 The cost of the trip will be approximately £125 for the round journey, the major portion of this may be paid in advance, on an instalment plan, which began this month Plans are under consideration for participation in some form by the Canadian Institute of Mining and Metallurgy, either at Toronto or Montreal, or both

THE thirty sixth general meeting of the Deutsche Bunsen Gesellschaft fur angewandte physikalische Chemie, the leading association of research workers, scientific workers, and technologists in Germany in the field of applied physical chemistry, will be held on May 25-27 in Vienna The subject of the symposium will be "Recent Progress in the Science of Metallurgy with particular reference to Light Metals" The arrangements have been undertaken by Prof Speckéter, director of the I G Farbenindustrie A G, managing director of the Griesheim Elektron works

THE Faraday Society has arranged a general discussion on "Photochemical Processes" to be held in the chemistry department of the University of Liverpool on April 17 and 18 Several distinguished chemists and physicists from the United States and the Continent have been invited to attend the conference and to send contributions There will be four sessions, each with an introductory paper, which, like all the contributions, will be distributed previously, and taken as read The four subjects are "Molecular Spectra in Relation to Photochemical Change", "Photochemical Kinetics in Gaseous Systems", "Photochemical Change in Liquid and Solid Solutions", and "Photosynthesis" The introductory papers respectively are by Prof R Mecke, Prof M Bodenstein, Prof Berthoud, and Prof E C C Baly

FROM a recent article in *De Visscherij Courant* it appears that the slipper limpet is multiplying in the waters of Zealand in Holland Frequent warnings by the coastal fishery authorities at Amsterdam have been issued, pointing out the necessity of exterminating these parasites in their early stages As the food of the slipper limpet is the same as that of the oyster, it is feared that a great multiplication of the pest would have a serious effect upon the quality of the Zealand oyster The Ministry of Agriculture and Fisheries desires to impress upon all persons who import Dutch or other foreign oysters, for the purpose of relaying, the importance of taking every precaution to avoid laying down oysters with slipper limpets attached to them Every oyster should be examined for slipper limpet spat before it is laid down, for once the slipper limpet has become established on an oyster ground, it is practically impossible to eradicate it

AMONG the many hazards of mining, one of the most difficult to avoid is the production of sparks by impact of rock, or of steel pick and rock It has been

shown that the picks of mechanical coal-cutters can strike sparks which will ignite firedamp In a recent report (No 62) issued by the Safety in Mines Research Board, M J Burgess and R V Wheeler report experiments which show that sometimes the impact of a hand pick on suitable hard stone will ignite firedamp It was not easy and the work suggests that the production of suitable conditions is a rare occurrence in practice

Messrs Francis Edwards, Ltd, 83 High Street, Marylebone, W 1, have just issued a useful little list of some 350 second hand works dealing with the arctic and antarctic regions

Applications are invited for the following appointments, on or before the dates mentioned —An assistant aeronautical engineer in the Army Air Corps of the Irish Free State—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin C 8 (Feb 24) An adviser in greenkeeping at the St Ives Greenkeeping Research Station—R B Dawson, St Ives Research Station, Bingley, Yorks (Feb 28) An assistant woman demonstrator in physics at Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (Mar 4) A professor of mechanical engineering in the University of Birmingham—The Registrar, The University, Edgbaston, Birmingham (Mar 9) A director of the Institute of Plant Industry, Indore, and agricultural adviser to States in Central India and Rajputana—The High Commissioner for India, India House, Aldwych, W C 2 (Mar 14) A head of Biological Department of Epsom College—The Headmaster, Epsom College, Surrey (Mar 31) A professor of philosophy at King's College, London—The Academic Registrar, University of London, South Kensington, S W 7 (May 7) A part-time assistant master, qualified to teach biology, at the Technical Institute, Gillingham—C Colles, Medway Technical College, Gillingham, Kent A resident engineer at the Rotherhithe Works of the South Metropolitan Gas Company—The Secretary, South Metropolitan Gas Company, 709 Old Kent Road, S E 15 A science master for physics at the Newport, Isle of Wight, Secondary School—The Director of Education, County Hall, Newport, Isle of Wight

Our Astronomical Column

Jupiter without its Satellites —Mr W F Denning writes "The planet Jupiter will be observed apparently without visible satellites on Feb 14 On that evening at 8 51 P M the first satellite will commence its transit across the disc of its primary The fourth satellite will have previously begun its transit, while the second satellite will be hidden behind the planet, and the third will be suffering eclipse The temporary obscuration of the satellites will continue for more than 2 hours and 15 minutes, for at 9 6 P M the first satellite will complete its transit Jupiter has nine satellites, all but five are so faint that small telescopes cannot reveal them To view the planet devoid of all visible satellites is a somewhat rare spectacle The writer was privileged to witness it on Aug 21, 1867, with a 4¼ in refractor, and a delineation of the appearance presented was afterwards given in the *Astronomical Register* Repetitions of the phenomenon will occur in 1932, and one of these which occurs in November may possibly be seen at Greenwich"

Pluto —A recent *Daily Science News Bulletin* issued by Science Service, Washington, D C, reports that Dr S B Nicholson and N U Mayall, of Mount Wilson, have been studying the mass and orbit of Pluto They first obtained corrections to Pluto's orbit by applying perturbations by the large planets, the period appears to be very close to 248 years With the orbit thus obtained they investigated the mass that was indicated by the observations of Neptune The two planets were in conjunction in longitude in 1891, and at their least distance apart, 19 units, in 1895 They made use of the data given by Dr J Jackson in his paper on Neptune's orbit (*Mon Not Roy Ast Soc*, June 1930) Two different methods of treatment, one including, the other excluding, Lalande's observations of 1795, gave for Pluto's mass 1 08 and 0 72 in terms of the earth's mass

Even the smaller of these masses would require the diameter of Pluto to be at least 7000 miles, assuming that the density is unlikely to exceed that of the earth Such a diameter is not impossible. With an albedo the same as that of the planet Mercury, it would make the visual magnitude in opposition about 14 The visual magnitude was stated to be brighter than the photographic one, and some of the estimates made it as bright as 14 M Baldet, using the 33-inch Meudon refractor, estimated the diameter as 0 2", or about 4000 miles But the limbs would be so feebly illuminated that the real diameter may be greater than his estimate

Solar Physics Observatory, Cambridge —The eighteenth annual report of the director of the Solar Physics Observatory, Cambridge, covering the period Aug 1, 1929–July 31, 1930, shows satisfactory progress, although much of the routine work has been hampered by somewhat extensive instrumental alterations, which, however, should greatly assist the work in future In particular may be mentioned the installation of an electric Gerrish drive for the 36 inch Common reflector in place of the old clock drive, and the re designing of the spectroheliograph The loss which the observatory has sustained through the sudden death of the first senior observer, Mr F E Baxandall, in October last, is referred to in appropriate terms Mr Baxandall's chief unfinished investigation, on the spectrum of β Lyræ, has been edited by the director, with the collaboration of Dr F Hogg, director of the Amherst Observatory, and published as vol 2, part 1, of the *Annals of the Solar Physics Observatory* An important addition to the instrumental equipment is a registering microphotometer, specially designed by the Cambridge Scientific Instrument Co, in close collaboration with the assistant director, Dr Carroll, the purchase of which was facilitated by a generous donation from Mr J H Reynolds, honorary treasurer of the Royal Astronomical Society A full description of the instrument has recently appeared in the *Monthly Notices of the Royal Astronomical Society* On the meteorological side, the results of a study, during the last five years, of the discharge of electricity from an elevated metal point during periods of disturbed weather conditions have been discussed in a paper presented to the Royal Society An extension of this work is now in progress.

Research Items.

A Benin Ivory.—In *Man* for January, Capt T A Joyce figures and describes a carved ivory ewer from Benin recently presented to the British Museum by the Christy Trustees The ewer is made of a section of elephant tusk covering an iron lining which is prolonged into a lip everted over the ivory jacket An iron foot also everted has been added at the base A wooden handle is fitted at the side, obviously a later addition, as it cuts into the carved design at the lower point of junction with the vessel The entire exterior of the ivory is covered with carving in rounded relief The ornament is arranged in two horizontal bands separated by a band carved in interlaced pattern At the base of the ewer is a second band of interlaced carving In the upper register is represented a catfish, a centipede, a frog, a two headed bird, and a fish, in the lower an elephant's head, a crocodile seizing a fish, and a grazing antelope The designs are excellent examples of the tendency towards symmetry characteristic of artists of all ages The elephant's head is seen from above, the tusks and ears have been curtailed to fit the space, and the trunk is divided into two diverging sections, each terminating in a human hand holding a branch The specimen is believed to be unique It was probably carved soon after Portuguese power began to spread on the west coast of Africa in the sixteenth century The shape of the ewer suggests European influence, but the artist has preserved his native style in all its purity The ewer is 9 2 in in height

Ancient Coastal Cultures of Northern Peru.—The results of a second Marshall Field Expedition to Northern Peru in 1926 are described by A L Kroeber in vol 2, No 2, of the *Memoirs*, Anthropology, of the Field Museum, Chicago The objective of the expedition was the coastal area between Lima and Nazca, and the aim to determine the cultural relations of the northern and southern Chimu areas and the cultural sequence within each The cultural history of the northern Peruvian coastal area may be summarised as follows (1) *Early Chimu* (formerly Proto-Chimu) This affords the first archæological evidence for a well developed culture of specialised type No origin or formative period is known, and no attempt to connect it with Ecuador, Central America, or Mexico has proved valid The people built terraced, small topped pyramids, higher than any erected el[illegible]ere in Peru The dead were buried in rectangular c[illegible]umbers, in a variety of positions Gold, copper, and their alloys, and perhaps silver, were melted and cast Tin and bronze were unknown The pottery was the highest achievement of any South American culture or people (2) *Middle* or *Tiahuanaco* appears to be an overrunning of an intrusive culture, possibly people, from the highlands It is represented at relatively few sites, and chiefly from its pottery, which is in fragments (3) *Late Chimu* Fundamentally an emergence of Early Chimu with [illegible]rements Now Chimu culture was no longer [illegible]ial, but extended far to the north of the [illegible]u domain Here it may have been ancient and [illegible] spread south At the moment of transition from prehistoric to historic, when the Incas conquered the Chimu area, the whole of the northern coast was under the influence of a ruler who lived at Chanchan Pyramids were no longer as high as under Early Chimu, and had broad tops, which were used for interments The custom prevailed of placing a small piece of copper in the mouth of the dead Metal was abundant; but bronze articles were in a minority. In textiles, mountain wool gave way to a preference for all-cotton fabrics Pottery had settled into a syncretised style of little originality but facile elegance The conquest of the Incas appears to have had little effect on Chimu culture, which indeed was externally prosperous and perhaps spreading up to the time of the Spanish Conquest

Rice as Food.—Among the populations of various countries the value of rice as a foodstuff is receiving increasing recognition, with the result that the consumption is gradually gaining ground Thus, in France, following an appeal by Prof Achard on behalf of rice grown in the French colonies, the importation has recently risen by more than 30 per cent In Italy, however, the cultivation of rice, far from expanding, is losing way, in spite of the fact that the soil and climate of certain districts are admirably suited to the production of rice of the highest quality Moreover, although Italy could produce twice or thrice its actual consumption, very little rice is being exported In an article published in the *Rendiconti* of the Royal Lombardy Institute of Science and Letters (Parts 11-15), Prof Luigi Devoto points out that the experience of the past few years has fully confirmed the view that, when properly prepared, rice is of great value, not only to healthy persons, but also to patients suffering from infectious diseases, affections of the digestive organs, certain skin diseases, obstinate lack of appetite, hyponutrition, and a number of other complaints In view, also, of the large amount of labour employed in the cultivation and marketing of rice, the question is one of considerable national importance at the present time, and Prof Devoto emphasises the advantages that would accrue from more extended production and consumption of this commodity throughout Italy

West Indian Fishes.—H W Fowler, in his paper, "The Fishes obtained by Mr James Bond at Grenada, British West India, in 1929" (*Proceedings* of the Academy of Natural Sciences of Philadelphia, vol 82, 1930), records eighty species, two of which are new, and several others are of special interest, since the fishes from this rich region are very little known Figures and detailed descriptions are given of the two new species, *Ariomma bondi*, the first of this genus from the Atlantic, closely related to the Hawaiian *Ariomma lurida*, and *Malacoctenus bondi*, which is recognisable by its colour markings

Polish Cladocera.—M Ramuet has described the cladoceran fauna of the lakes in the coastal region of the Polish Baltic, "Untersuchungen uber die Cladoceran fauna des polnischen Ostseekustenlandes" (*Bulletin International de l'Académie Polonaise des Sciences et des Lettres* Classe des Sciences Mathématiques et Naturelles, série 3 Sciences Naturelles (II), N 5 6, B II, 1930) There are ten large lakes, from 3700 metres to 380 metres in length and 900 metres to 270 metres in breadth, and several smaller lakes of various kinds, some of which are in the neighbourhood of peat moors The larger lakes have a moderately developed coast line, and are without islands and deeply indented bays A short description of each lake with notes on the flora is given, and in some cases the more important animals Fishes abound in most of the large lakes and usually the bivalve *Dreissensia polymorpha* is found in large quantities In the systematic portion a record is made of the species of *Cladocera* in each lake, which show a certain similarity and belong to a type characterised by the presence of *Diaphanosoma brachyura*, *Daphnia cucullata*, and

Bosmina longirostris Seventy species in all are now known from the coastal regions of West Prussia, including those from the Polish coast land and the Danzig Free Territory The paper is well illustrated by photographs of the lakes themselves and their surroundings, and by line drawings of the *Cladocera*

Musculature of the Larval Shrimp —The report for 1929 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool, edited by Prof James Johnstone and Dr R J Daniel, contains papers on the hydrographic observations made during 1926–29 by Dr Daniel, on the surface drift bottle experiments in the Irish Sea, July 1925–June 1927, by Dr Daniel and Miss Mabel Lewis, and on the abdominal muscular system of the zoea and mysis stages of the shrimp (*Crangon vulgaris*) and their bearing on phylogeny, by Dr Daniel The hydrographical investigations have been carried out with the assistance of grants from the Ministry of Agriculture and Fisheries Sea water samples were collected from the Irish Sea between Holyhead and Dublin, and at the same time drift bottles were liberated from the places where the water samples were taken Dr Daniel's work on the musculature of the larval shrimp is of much interest Following his former papers dealing with the adult shrimp (*Crangon vulgaris*) and the mysid *Praunus flexuosus*, in which work distinct differences were found in the muscles of the two species, the present paper investigates the larvæ of *Crangon* Even in the first stage, the so called zoea, the muscles are very like those of the adult, which fact might be regarded as direct evidence against its schizopod ancestry A more probable interpretation is, however, that as the metamorphosis is much abbreviated compared with some of the more primitive Crustacea, such as most of the euphausiids, the development is compressed by the early addition of adult characters, and that during the larval period adult organs or characters as well as complete larval stages may be anticipated The author is of the opinion that "it may be taken that the occurrence of adult muscular structure in the zoea and mysis of *Crangon vulgaris* is a further indication of this gradual suppression of complicated larval series in the higher Crustacea "

Root and Shoot in the Angiosperm - Mrs Arber has recently published in a more extended form (*New Phytologist*, **29**, Dec 1930) the discussion of this subject that she presented at the International Botanical Congress at Cambridge From the point of view of formal morphology she concludes that stem and leaf should not be treated as discrete morphological entities, but that root and shoot belong to primary and equivalent morphological categories She points out, in this latter connexion, that root and shoot alike normally give rise to other like units, the shoot producing lateral shoots, the root lateral roots This conception of the morphological equivalence of shoot and root seems to meet with little difficulty in the dicotyledon, but the fibrous root system of the monocotyledon, often forming anew at each node and with no very permanent main system as a prolongation of the main axis, may raise a doubt as to whether this view is fully in accordance with all the facts There are obvious difficulties in the way of extending this view to include the relations of shoot and root system in the Filicales The paper contains an interesting review of various morphological facts, gathered mainly from the author's investigations of the Gramineæ, which bear upon the relation of leaf and stem Thus, leaves terminal upon the axis are described from three genera of grasses Axes with dorsi ventral symmetry are cited, as well as leaves with characteristically radial organisation

Bathymetrical Work in the Baltic —Various charts of the northern part of the Gulf of Bothnia show notable divergences, especially in deeper water. These are due no doubt to different interpretations of the soundings With the view of obtaining a detailed bathymetrical chart of that part of the Baltic, it was surveyed with an echo sounder in the summers of 1927–29 The methods and results are described by H Renqvist in *Havsforsknings Institutets Skrift*, No 68 (Bathymetric chart of the Bothnian Bay and the North Kvark) Several thousand soundings were taken and allowed the construction of a detailed map showing an extraordinarily uneven floor, a state of affairs that was overlooked in the deeper water when few data were available Dr Renqvist insists that many of the former discrepancies were due to soundings having been wrongly placed on the chart On an irregular floor a slight error in position might well have a wide result He claims that errors arise when a ship has to stop for sounding, for it is then difficult, without cross bearings to land, to fix the true position, since the slowing down and restarting of the ship vitiate calculation of average speed and so of position. In echo sounding there is a uniform speed on the definite course throughout, and the shorter time occupied in taking such a line of soundings reduces the period during which one is unable to take bearings to the land This also obviates sources of error

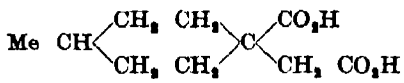
The Gas Equation —In the issue of the *Physikalische Zeitschrift* for Dec 1, 1930, Dr E Neusser, of the Vienna Technical High School, examines the experimental material available for hydrogen and carbonic acid gas in order to determine the variations with pressure and temperature of the two quantities a and b of van der Waals' gas equation Observations of volumes at two pressures near together and at the same temperature are used to calculate a and b over as wide a range as possible The units used are the litre, atmosphere, and gram molecule of the gas In both gases a and b are found at constant temperature to decrease with the pressure, the curves for a and b being very similar At constant pressure above the critical point both a and b increase with increase of temperature, while below the critical point there is a rapid fall of both a and b from their values for the gas to their values for the liquid For the lowest temperatures for which the values have been calculated the decrease is of the order of 50 per cent The curves given in the paper show why the attempts to modify the van der Waals equation to bring it into closer agreement with observation[illegible] met with so little success

Aero-navigation by Wireless —The difficulties which have to be overcome in navigating an aeroplane in a fog, which the light from a beacon cannot penetrate, seem at first sight to be almost insuperable As it cannot remain at rest like a ship on the sea, it is sometimes forced to make a dangerous landing In the *Proceedings* of the United States National Academy of Sciences for Nov 15, Messrs H Diamond and F W Dunmore, of the Bureau of Standards, describe a method of landi[illegible]n with the [illegible]se fog When flying overland two [illegible]chase of [illegible]erving sets are used One is the usua[illegible] which receives the radio beacon signals when flying between cities, and also spoken orders For landing at the proper angle, a short wave receiver is used, the signals having a wave length of 3 metres The aeroplane flies midway between waves coming from two beam antennæ When the aeroplane is steering in the correct direction, the amplitudes of the vibrations of two reeds on the pilot's board are equal When it moves to the right or the left of the true course, this is shown

at once by one of them having a larger vibration than the other. A somewhat similar arrangement, using lower power and a smaller loop antenna, is used to give the pilot the direction of the runway on which he is to land. The pilot knows when he is approaching the boundary of the field on which he intends landing, as he hears a special signal in the headphones which gets louder as he approaches the field but disappears completely when he is directly over the antenna, which is placed on the edge of the field. To tell the proper angle at which he is to glide, high frequency signals are directed along a narrow beam. The line of greatest signal strength is along the axis of the radio beam, and at a short distance away it drops considerably. The pilot should hit the axis of the beam and then start to drop, keeping the signal strength constant, the approach to the transmitter compensating for the greater distance from the axis. This gives very approximately the proper landing curve; the instrument indicates whether he is flying too high or too low. A vertical pole antenna and a horizontal doublet antenna fixed on the aeroplane are used to receive the landing system signals.

Determination of Reducing Sugars.—Schuette and Terrill, in the December number of the *Journal of the American Chemical Society*, describe experiments on the use of cupropotassium carbonate solution, first proposed by Soldaini in 1876, in the determination of reducing sugars. They investigated four types of solution and show that it is doubtful whether Beyersdorfer's form of the solution can be used as a selective reagent for levulose, as has been asserted. The effects of varying the experimental conditions were fully studied and mathematical expressions described.

Strainless Ring Structure in Cyclohexane.—In a communication to the Editor, Dr. Muhammad Qudrati-Khuda, of Presidency College, Calcutta, states that he has found evidence of a 'strainless ring' structure in cyclohexane. He has discovered that 4-methyl-cyclohexane-1-carboxy-1-acetic acid,



is capable of existing in four stereoisomeric modifications. The stabilising of these forms is attributed, as in decalin, to a restraint of the internal rotatory movement of the carbon atoms, brought about in this case by substituting heavier groups for some of the hydrogen atoms of cyclohexane. A fuller account is to be published shortly.

Molecular Iodine.—The separation of two forms of molecular hydrogen (both being represented by the formula H_2) has naturally raised the question of whether other diatomic gases can be similarly treated. From its band spectrum it would be anticipated that this should also be possible with iodine, and an attempt on this substance, which appears to have been partly successful, is described by R. M. Badger and J. W. Urmston in the December number of the *Proceedings of the National Academy of Sciences*. The method adopted was photochemical; only one form is excited by exposure to the green line of mercury (λ5461), and this can then be removed by a reaction with hexene. After a prolonged treatment, evidence was obtained that the residual iodine molecules had different fluorescent properties from the original mixture of the two forms, but the amount of separation which had been effected was evidently not large. The reasons for this are not clear, but the authors consider the method sufficiently promising to be followed still further.

Specific Heats and Entropies of Metals.—The specific heats of thallium, calcium, and magnesium from 10° to 200° abs. have been determined by Clusius and Vaughan, whose results are given in the December number of the *Journal of the American Chemical Society*. The extrapolation to absolute zero could be made with some certainty, and thus the absolute entropies calculated. The results for the atomic heats were higher in the case of thallium and lower in the case of magnesium and calcium than those of previous workers. Whilst in the case of calcium (which was found difficult to free from hydrogen), the atomic heat curve could be very approximately represented with a single Debye function, this was not possible with thallium, the θ value of which decreased below 17° abs., nor with magnesium, the θ value of which increased appreciably below 30° abs. A more rapid decrease of atomic heat than is to be expected from the T^3 law has previously been observed only with copper and tungsten. The vapour pressure constants are calculated from the results. Although the error is of the order of 25 per cent, it is claimed that it agrees very well with that given by the usual statistical formula (0·443 and 0·493); the entropy of magnesium vapour at 1 atm. and 25° being 35·29 units determined empirically and 35·51 from theory.

Entropy of Hydrogen.—Recent progress in the development of statistical mechanics and the discovery of the two forms of hydrogen molecule foreseen by the wave theory have made it necessary to revise carefully the calculation of the entropy (or free energy) of hydrogen from spectroscopic and other data. This question is dealt with in two papers by Giauque in the December number of the *Journal of the American Chemical Society*. In the first of these a considerable simplification is introduced into the method of calculating the free energy from spectroscopic data. Every state is assumed to possess the same statistical weight; the statement that a certain state has an *a priori* weight of three means that the state is really three states which have been grouped together for simplicity of calculation, having so nearly the same energies that they are affected in nearly the same way by temperature but really individual states in a statistical sense. Previous calculations are shown in some cases to be in error. A simple new derivation of Reiche's well-known equation

$$S^\circ = R[\ln Q_r + T\, d \ln Q/dT]$$

is given and it is believed that this equation will hold for all states, including multiplicities due to nuclear effects such as spin. When the necessary atomic or molecular levels are known Q may be calculated. In the second paper the author considers the case of hydrogen, on the basis of recent data (NATURE, Mar. 22, 1930, pp. 462-463), and "the numerous misunderstandings which have arisen concerning the effect of nuclear spin on the entropy of hydrogen" are cleared up. A new calculation of the heat capacity of hydrogen, without assuming rigidity of the molecule, is given. The absolute entropy of hydrogen at 25° C. is found to be 33·98 cal. per 1° per mol. This, however, is not the value to be used in combination with $\int C_p \ln T$ for other substances, since an entropy of mixing must be subtracted on account of the existence of ten kinds (one para- and nine ortho-) in the solid. A detailed discussion of this point is given, and it is concluded that, whilst some uncertainty may remain as to the effect of nuclear spin on other substances, no reasonable doubt exists as to the value of the entropy of hydrogen.

Light Intensity of a Quartz Mercury Lamp

DR TSUNESABURO ASADA, of the Shiomi Institute of Physical and Chemical Research, Osaka, Japan, has sent us an interesting communication describing measurements he has made on the intensity of the light emitted by a quartz mercury lamp The instantaneous values of the light intensity at several points of the luminous part of an alternating current quartz mercury lamp, the terminal voltage, and the current were all measured by the help of an

FIG 1 FIG 2

oscillograph In carrying out the test, the image of the lamp was projected by means of a lens on to a screen

The intensity of the light on each part of the image was found by a vacuum cæsium photoelectric tube The photoelectric current was first amplified by a triode, which was found to give no deformation of the shape of the current wave

In Fig 1 an oscillogram is shown of the current I_c flowing in one of the anodes C and the terminal voltage V_{ac} across it This oscillogram shows clearly that so long as there is an appreciable current through the electrode, its terminal voltage is practically constant

Fig 2 is an oscillogram of the current I_c and the intensity of the light G_c in the neighbourhood of the anode C From these two oscillograms it is concluded that so long as the terminal voltage is constant the intensity of the light emitted is directly porportional to the current

A special direct current mercury lamp was made of transparent fused quartz which could be used at various current densities The light intensity of the lamp was measured by a monochrometer and a vacuum photoelectric tube It was found that the relation between the intensity of the light G, the current I, and the potential difference V between the anode and the cathode could be expressed by a formula of the form

$$G = kI(V - V_0)^n$$

where k and V_0 are constants

V_0 is the least potential difference between both the electrodes required to maintain the arc, and is a constant for a given lamp For a given wave length, the number n is constant

It was found by plotting curves having log (G/I) as ordinates and log $(V - V_0)$ as abscissæ that, provided the potential difference was not very small, the resulting curve was a straight line The formula is an experimental one It shows that when the temperature of the mercury vapour is raised by increasing the terminal voltage, the radiations of longer wave-length increase much more rapidly than those of shorter wave length This radiation, therefore, follows quite a different law from black body radiation

Experiments with the alternating current mercury lamp show that the formula given above still holds, provided we take the mean value of the light intensity, the effective potential difference between one of the anodes and the cathode, and the effective value of the input current The value of n, however, is different from that for the direct current mercury lamp

Marine Biology in Madras and Ceylon

THE Administrative Report for the year 1928–29 of the Madras Fisheries Department, by Dr B Sundara Raj, Director of Fisheries Madras (Report No 1 of 1930, *Madras Fisheries Bulletin* vol 24, 1930), embraces a large variety of subjects Part 1 describes the activities of the Department, including marine and estuarine fisheries, inland food fishes, pearl and chank fisheries, biological specimen supply, anti malarial and socio economic work, and fish industries Part 2 deals with finance, Part 3 with staff and equipment, with various appendices The importance of investigation relating to food fish is emphasised as being the primary object of a scientific department of fisheries It is evident that here great difficulties are encountered from lack of proper accommodation and staff, nevertheless, it is shown that progress is being made Research on marine fisheries was undertaken by the trawler *Lady Goschen*, and on three shore stations at West Hill (Calicut), Krusadai Island, and Vizagapatam, the first two stations being provided with small laboratories, and at the Madras Aquarium laboratory work is being done on the early stages of the edible oyster Survey of fishing banks and experimental trawling was carried on, including extensive cruises from Mangalore to Cape Comorin, fishes and certain invertebrates were identified and plankton collections made So far only the otter trawl is used for fishing The Danish seine could not be employed, as the motor boat originally intended for the purpose was condemned as too old for the open sea Proposals have been made to the Government for the purchase of a small motor boat, and a drift net and long lines for surface fishing are ordered

Investigations in the Collair Lake on the prawn *Peneopsis monoceros*, the "Chakku Royya", were continued, but still little is known about the breeding grounds of this commercially important crustacean. Again the absence of staff for this work is to be regretted Deep water tank fishing in the Mopad Reservoir was satisfactory, a backwater net from Ennore, drift nets, and long lines being used with good results Fish breeding and stocking experiments appear to have been unsuccessful for various reasons Pearl oysters still continue to make sudden appearances and disappearances It is proposed to undertake extensive research connected with this subject when the Krusadai Biological Station is instituted, meanwhile regular inspection of the pearl banks goes on, and any spat falls will be noted

The Fisheries Training Institute, Calicut, provides courses of study in the elements of navigation and handling of sailing boats, with classes in fish-curing, and pupils are on the increase

The Administration Report of the Marine Biologist of Ceylon for 1929 (Part 4—Education, Science, and Art (G) July 1930), by Dr Joseph Pearson, contains information on the pearl fishery, Gulf of Manaar, the window pane oyster fishery and chank fisheries, with fishery statistics, report of the second assistant marine biologist and of the marine superintendent

The year 1929 was unfortunate for several reasons, and the absence of Dr Pearson made it necessary to abandon the inspection of the new paar which was discovered in the region of Twynam's Paar, and which in the previous February and March was densely covered with oyster spat for a considerable part of its area of some 30 square miles The usual survey of the Pedro and Wadge Banks was also abandoned.

In November, however, a portion of the area off Chilaw was examined by a running survey by dredge for the purpose of charting the paar area, and a chart is given with the present report In this charting no idea can be given of the number of oysters present, but a picture is provided of the general limitations of the paar ground and the general slope of the area It also shows the nature of the paar and will indicate the presence of oysters, although small patches of oysters may be missed Current observations on the main Pearl Banks were continued. There is a westerly trend in all currents which would tend to take all pelagic oyster larvæ present when the observations were made out into the deep water, where they would be lost

Dr Pearson has obtained all particulars for a new boat to take the place of M L *Lion*, which has been condemned The new boat is to be of the modern Scotch type of fishing boat, with a length of 45 feet, beam 13 feet 6 inches, draught 5 feet 6 inches

Afforestation in New Zealand.

THAT private companies have been formed in New Zealand to promote afforestation work is well known Many of these companies have now been federated into the New Zealand Timber Growers' Association, which publishes an official quarterly known as the *Timber Growers' Quarterly Review*, the second number (for September last) of which has recently appeared This number deals primarily with reports, etc , of the 1930 Conference of the member companies of the Association

The attitude of the companies towards this new national industry and the aims and objects of the latter are well portrayed and merit a close study in Great Britain The member companies in the Association now represent a combined capital of £5,000,000 " Afforestation in a minor way ", it is truly said, " is practically useless and would really mean nothing whatever either to New Zealand or the Empire , and although the companies represented in the Association to day have joint afforestation schemes in hand comprising over 250,000 acres, the desired objective is a million acres of exotics " The magnitude of the task can be readily appreciated, as also the value of combining

The delegates to the Conference had the opportunity of meeting the Prime Minister, Hon G W Forbes, who has recently been at the Imperial Conference in London, and the Minister responsible for the N Z Forest Department, the chief matter under discussion being the important one of future co operation in research work Here the Association is taking the broadest views The president, Mr W Fraser, in discussing the question with the Minister, pointed out that while the Association "had planned in the first instance to establish its own arms of research, the successful functioning during the past 12 months of the Biological Committee, to which not only the Association but also the Bureau of Scientific and Industrial Research, the Cawthron Institute, the Sawmillers' Federation, and the Forestry Department had contributed brains and money, had indicated the possibility of still further co operation in matters that are equally of joint interest and joint advantage "

The New Zealand Timber Growers' Association is said to consist largely of business men who may be regarded as trained executives and organisers It also embodies technical forestry men of wide and sound experience and established judgment It regards research as being a most important and vital adjunct or partner of business, and is prepared to forward energetically and substantially to endow useful research along business lines in the interests of afforestation This was the message of the 1930 Conference

There was no attempt on the part of the Conference to minimise the value of the work (much of it of an experimental nature) of the State Forest Service during the past quarter of a century Far otherwise But the importance of the provision of a large volume of softwood timber, which it has been shown can be grown on large areas of available land, has been fully realised , also that this work, to be done expeditiously, is a purely business proposition, quite outside the capacity of a State Department, which could not be granted the funds from the public purse to carry it on with such rapidity

The realisation of this fact and the coming of the private companies, run on investors' capital, is remarkable and furnishes evidence of a shrewd foresight on the part of the New Zealanders Not less remarkable, if we compare it with the reduplication of research work in different institutes and so forth in Great Britain, is the swift recognition by the leaders of the Association that co operation in research with the existing centres would be the most practical step to take, instead of bringing into being new and independent ones

Archæological Investigation in Oregon, U S A.

RESULTS of archæological investigation on the middle Columbia River undertaken by the University of California in 1924–26 are recorded by W D Strong, W E Schenck, and J H Stewart in the University's *Publications in American Archæology and Ethnology*, vol. 29, pt 1, under the title "Archæology of the Dalles-Deschuttes Region" This area was chosen for investigation as the geographical and economic conditions at this point of the river are such as to have made it one of great importance to primitive man, and it must have been occupied from a remote period.

Seven distinct types of evidence were exposed, these including the Wakemap Mound, village sites on Miller's Island, burials—cremation and pre- and post-Caucasian inhumations—as well as numerous petroglyphs Of these, the most important were the mound, on account of the depth of the deposit containing evidence of occupation, and the cremation burials, on account of the richness of their culture It was noted that the culture of the cremation burials was quite distinct in character from that of the mound, the former being of an entirely ceremonial and ornamental character, while the objects from the mound were entirely utilitarian On the whole, however, there was good reason to think the two are connected, and to regard them as representing two sides of a single culture It is also suggested that the old type conical, semi subterranean house is connected with the mound culture, but that connexion is not yet proved

It seems probable that most of the rock carvings are to be associated with the mound and cremation culture, most of them being attributed to the Wakemap people There is a lack of relationship between the post-Caucasian burials and the mound and

cremation culture, but some can be assigned to the Sahaptin The relationship of the pre Caucasian burials at the upper end of Miller's Island to the Wakemap culture is not yet clear

The general conclusion as a result of the investigations seems to be that the earliest comers to this region possessed a culture, already well developed, which was basically Salish After a long period it was gradually modified by coastal influence, very probably through Upper Chinookan tribes, but also probably from the centre of Washington This is manifested principally in the art, which combined the plateau and coast styles to produce a local style, expressed in the petrography and the ground and sculptured stone work The ultimate fate of the Wakemap and cremation culture is unknown, but the continuity of Salish culture was broken by the Sahaptin and Waiilatpuan migrations The Dalles Deschuttes Salish disappeared They may have been absorbed by the Wasko and Wishram

Malayan Medicine

THE two publications on Malayan medicine, referred to in NATURE for June 7, p 862, have now been supplemented by "The Medical Book of Malayan Medicine" (*The Gardens' Bulletin*, Straits Settlements, 1930, vol 6, part 3), edited by Dr J D Gimlette and Mr I H Burkill

In 1928 the attention of the two editors was directed to a manuscript in the possession of the Pharmaceutical Society, entitled "This is the Medical Book of Malayan Medicine" The history of the manuscript has been lost, but the editors, from their expert knowledge of the subject, have been able to suggest that the original document, of which this manuscript is a translation, made by a *munshi* (teacher of languages) named Inche' Ismail, consisted of a series of notes on diseases and the prescriptions necessary to cure them, made by a native practitioner, probably resident in Penang The compiler seems to have allowed a British official in Malaya to have the notes translated by Ismail, possibly with the view of the translation forming part of the collections assembled in the Straits Settlements for display on behalf of that Colony at the Colonial and Indian Exhibition held in London in 1886

The manuscript, corrected and edited, is now published with Dr Gimlette's diagnostic notes of the diseases which appear to be indicated by the Malayan practitioner's descriptions of symptoms, and with Mr Burkill's determinations of materia medica There are 543 prescriptions in the book, ranging from a village simple such as the juice of a banana tree, used for a disease which, judging from the symptoms, Dr Gimlette thinks, may be either rheumatic or dengue fever, up to No 289, in which a concoction of 29 drugs is prescribed for anointing the body in cases of smallpox This is not a record for poly pharmacy, for *Confectio Damocratis*, supposed to have been invented by Mithridates the Great (born 134 B C), contained at least 44 ingredients, and had a great reputation in the Middle Ages as a prophylactic against the plague

Modern medicine is not likely to reap any considerable benefit from the labours of the two learned editors, but this, like the two previous publications in the same series, is of great interest and importance as a contribution to the history of the development of medicine In this connexion special mention should be made of the glossary of Malayan names for drugs and diseases, which is arranged as part of the excellent index to the volume

University and Educational Intelligence.

CAMBRIDGE —The Faculty Board of Physics and Chemistry have reappointed Dr J Chadwick, of Gonville and Caius College, assistant director of radioactive research at the Cavendish Laboratory

The prize of £30 from the Gordon Wigan Fund for a research in chemistry in the year 1930 has been awarded to P S H Henry, of Trinity College, for a dissertation entitled "The Experimental Determination of the Specific Heats of Gases"

Two new professorships have been established by Grace of the Regent House One is in geography, and the first holder will be Mr F Debenham, of Gonville and Caius College The other is in experimental psychology, and the first holder will be Mr. F. C Bartlett, of St John's College

LONDON —The Julius Mickle Fellowship was awarded to Dr C H Andrewes for 1931, for his research work on viruses

OXFORD —On Feb 3 Congregation passed a decree accepting the offer of the Forestry Commission and the Secretary of State for the Colonies to make contributions at the rate of £5000 a year as from March 1929 to July 1931 to the maintenance of an Imperial Forestry Institute in Oxford, the University undertaking to make during the same period contributions to the Department of Forestry at a rate not exceeding £300 a year in addition to its current contribution Mr C G Morison, in proposing the decree, explained that it is a renewal of a former decree The Institute, which has now been in existence for about five years, is active in research and in giving post graduate instruction The relations between the Institute and the University are at present engaging the attention of Council

A COURSE of lectures on "Dielectrics" will be delivered at the Northampton Polytechnic Institute, St John Street, E C 1, by Dr L Hartshorn, on Mar. 4, 11, 18, and 25 They will deal with the phenomena of leakage, absorption, power losses in alternating fields, dielectric strength, and so on, and will be especially addressed to those concerned with the manufacture and industrial applications of insulating materials

MR A T STARR has been appointed to the staff of Faraday House Electrical Engineering College, London Mr Starr took the London B Sc, with first class honours in mathematics, in 1925, receiving also the Lubbock Prize At Cambridge he obtained a major scholarship at Corpus Christi College, took a first class in both parts of the Mathematical Tripos, and received honourable mention in the Smith's Prize examination For the past three years Mr Starr has been working in the laboratories of the International Telephone and Telegraph Company

A CONFERENCE on "Changing Education in an Old Empire", organised by the New Education Fellowship, will be held at Bedford College, London, on July 24 30, under the presidency of Sir Percy Nunn Mr K Lindsay is the honorary secretary, to whom all communications should be addressed, c/o New Education Fellowship, 11 Tavistock Square, London, W.C 1. It is hoped that the Conference will lend support to the project of establishing in London a permanent educational institute to act as research bureau and central clearing house of educational ideas for the Empire.

Birthdays and Research Centres.

Feb 12, 1872 —Prof A J EWART, F R S, professor of botany in the University of Melbourne

The chief investigation I have now in progress is an attempt to produce graft hybrids between species of Eucalyptus, which I have been working on for more than ten years Another problem in hand is in regard to the influence upon animals of the prolonged ingestion of plants containing saponin

Feb 16, 1848 —Prof HUGO DE VRIES, For Mem R S, formerly professor of plant anatomy and physiology in the University of Amsterdam

My chief investigation now in progress is on the inheritance of characters of new mutants of *Œnothera Lamarckiana*

A subject to which I think attention might usefully be given is the difference and analogy between phylogenetical and explosive mutability

Feb 17, 1884 —Prof JOHN READ, professor of chemistry in the United College of St Salvator and St Leonard, University of St Andrews

The endowed chemical research laboratories at St Andrews have accommodation for about sixteen research workers, apart from members of the staff, and as a rule this is fully utilised Most of the numerous publications which have appeared from this organic chemical school during the last twenty-five years have been concerned with the chemistry of sugars and the more complex carbohydrates, stereochemical problems also have been studied

My students have continued the stereochemical tradition, in publications upon such subjects as the optical resolution of simple asymmetric compounds and stereochemical relationships in the hydrobenzoin series A second series of investigations deals with the formation of halogenohydrins from unsaturated compounds Our chief field of work, which maintains the traditional interest of the school in natural organic products, is the systematic chemical and stereochemical study of menthols, menthones, piperitones, phellandrenes, carvone, and related substances derived directly or indirectly from essential oils of plants We are interested also in the biochemical origin and ancestry of these substances In my opinion, results of great biochemical value would attend systematic collaborative work between organic chemists and botanists in tracing the chemical effect of hybridisation, as evidenced, for example, in the composition of essential oils in a suitable genus such as *Eucalyptus*

Feb 17, 1890 —Dr R A FISHER, F R S, head of the Statistical Department, Rothamsted Experimental Station, Harpenden, Herts

The great event of our generation for the progress of the human mind is, I believe, the development of a comprehensive and rational theory of inheritance If this 'mystery of mysteries' is capable of a simple and definite formulation, need any biological problem, however complex, be regarded as incapable of exact treatment?

The new knowledge has so far had no appreciable effect on the means whereby practically important improvements are made in domesticated animals and plants The characters which confer value are always quantitative and depend upon the cumulative effects of numerous separable factors Selection of favourable combinations as practised from time immemorial by breeders, such as Chevalier or Burbank, is still the only effective method What is needed, and seems now practicable, is the quantitative evaluation by extensive measurements, combined with systematic mating, of the selective possibilities of the populations available for selection This is an almost untouched field and will remain so so long as genetics and biometry are mutually exclusive studies

Feb 26, 1864 —Mr JOHN EVERSHED, F R S, lately director of the Kodaikanal and Madras Observatories

The main objects of my present research are to determine the solar rotation at high levels, and the general shift towards red of the calcium, hydrogen, and iron lines Previous work here has shown that prominences give a daily angular speed of rotation about 3° in excess of that given by the reversing layer I shall attempt to determine whether this excess holds throughout the sunspot cycle, or is connected with sunspot frequency

My measures show that the shift of the lines *H* and *K* towards red exceeds the Einstein effect, both in prominences and chromosphere, by 0 007 A, and iron lines at the limb in the same spectral region give nearly the same excess The cause of this 'limb effect' is a mystery, and measures of solar spectra will be continued in the hope of throwing new light on the problem

Societies and Academies.

LONDON

Royal Society, Feb 5—C F Jenkin The pressure exerted by granular material A model consisting of a rectangular frame holding a single layer of steel discs was made which reproduces the leading phenomena observed in sand, particularly the effects of 'arching' The solutions are found for the forces exerted by the discs under a number of different conditions, including three typical examples of arching In the light of these results, an apparatus was designed for measuring the pressure of sand on a retaining wall in which *end arching* was eliminated The most important new result obtained is that the centre of pressure may be very much higher than was supposed, and that the pressure distribution on the wall is quite different from the triangular distribution commonly assumed —F L Arnot The diffraction of electrons in mercury vapour An investigation of the angular scattering of electrons in mercury vapour over an angular range of from 18° to 126° is described Results are shown for fifteen different velocities of the primary beam between 8 and 800 volts All the scattering curves show distinct maxima and minima, maxima of four different orders being obtained The absolute scattering of 82 volt electrons between 15° and 60° has been redetermined —S Rama Swamy On the transmission of light by thin films of metal Quantitative observations on the transmission coefficient of metal films for different wave lengths of light in the visible range and its changes on heating the films are described and discussed Thin films of gold and silver, obtained by cathodic sputtering, were heated in a furnace and their absorption spectra photographed at different temperatures, a pointolite lamp being the source of light The transmission coefficient was deduced from the photometric measurements of the spectrograms —D C Colbourne The diurnal tide in an ocean bounded by two meridians The diurnal tide is considered in an ocean on a rotating globe bounded by two meridians 60° apart and of uniform depth 12,700 ft The solution of the general dynamical equations of the tides satisfying the required conditions is obtained by the introduction of a null function according to the method developed by

Goldsbrough By means of this solution the tidal amplitudes and phase angles at numerous points have been calculated Amplitudes of the diurnal tide are considerably smaller than those of the semi diurnal tide, and the range of values obtained for the phase is unusually limited

Linnean Society, Feb 5 —Miss S Finnegan Brachyura collected by Dr Crossland on the *St George* Expedition to the Pacific, 1924–25 Sixty five species of crabs were collected, of which eight are new, and one new variety is described In addition, the opportunity has been taken to analyse all the existing records of Brachyura from the region in question, and to attempt to identify the various geographical elements in the fauna The chief conclusions are that certain genera may be regarded as typically American So far as the scanty geological evidence goes, these genera do not date further back than the Pliocene There is evidence that the similarity between the Indo Pacific and Panamic faunas was greater in the past that it is to day

DUBLIN

Royal Irish Academy, Jan 26 —G H Nall Irish sea trout This paper deals with the results obtained from the examination of some 2200 samples of scales taken from sea trout from ten river systems in the west of Ireland The average age rate of growth, age at migration and at first return from the sea to spawn, the number of spawning marks, etc , are determined and comparisons made with similar results obtained from the examination of sea trout scales in various rivers in Scotland The chief characteristic of the sea trout from the west of Ireland rivers which emerges from this study is the relatively small size attained The average duration of life is comparatively short The proportion of sea trout which returns to the river, after only a short stay of a few months in the sea, is high It is suggested that some of the rivers are deficient in food for the large numbers of fry which are present The low growth rate during sea life is possibly due to the absence of rich feeding grounds adjacent to the mouths of the various rivers

CRACOW

Polish Academy of Science and Letters, Nov 10 —W Kapuschinski The fluorescence of zinc vapour The saturated vapour of zinc, excited by ultra violet light, gives a fluorescence spectrum containing lines and bands Details of the study of this spectrum are given —**L Orkisz** The final orbit of the comet 1925, 1 (Orkisz) The elements given are based on observations made between April 5, 1925, and May 12, 1926 —**K Dziewonski, B Grünberg, and Mlle J Schoenowna** Researches on the acenaphthene sulphonic acids —**S Kozik** Two chlorites in veins from Haute Tatra These chlorites occur in veins about 2 cm thick in granite, their composition is quite different from that of the granite —**F Bieda** Remarks on the nomenclature and classification of certain species of Nummulina (1) —**J Zerndt** *Triletes giganteus*, a huge megaspore found in coal This spore has been found in coal from nearly all levels of Polish coal strata It measures 6 4 mm in diameter and is the largest megaspore known —**M Kostowiecki** The relation between Hassal's corpuscles and the neighbouring blood-vessels in the thymus of the human fœtus

SYDNEY

Linnean Society of New South Wales, Nov 26 —O H Sargent Xerophytes and xerophily, with special reference to protead distribution The author records observations on the distribution of Proteads in Western Australia, particularly in its relation to soil conditions and rainfall He details experiments in estimating the water needs of a few species, and also in estimating the degree of transpiration by the two types of leaf (broad leaves and needles) found on *Hakea trifurcata* —**W L Waterhouse** Australian rust studies (3) Initial results of breeding for rust resistance Following upon specialisation studies of *Puccinia graminis tritici* in which it was shown that prior to 1926 two groups of forms, namely, (1), 43, 44, and 54, and (2), 45, 46, and 55, were present in Australia, breeding for complete resistance was undertaken Many commercial varieties behave reciprocally to these two groups The inheritance of resistance was traced in the cross between these, as well as between other varieties Resistance is dependent upon a single dominant factor in these varieties —**I A Brown** The geology of the south coast of New South Wales (3) The Monzonitic Complex of the Mount Dromedary district The main intrusion probably assumes a laccolithic form A number of rare rock-types are included Detailed petrographic descriptions of the various types are given, and these are compared with rocks in other parts of the world The mineralogical and chemical evidence of consanguinity of a number of types supports the field evidence of the comagmatic origin of the monzonitic types The possible origin of the nepheline bearing and garnet bearing rocks is considered, and is compared with that of similar occurrences at Magnet Cove, Arkansas, the Fen District, Norway, and elsewhere —**G Carey** The leaf buds of some woody perennials in the New South Wales flora Leaf buds in New South Wales are divided into three classes (*a*) scaly, (*b*) intermediate, and (*c*) naked A great variability of bud types is shown among genera of any one family, and among the species of a single genus The evidence points to the fact that bud structure and development are influenced by the physiology of the shoot —**H L Jensen** Notes on a cellulose decomposing soil fungus of an unusual character A fungus, probably belonging to the genus *Botryosporium*, was isolated from an English field soil with addition of manure This organism proved very sensitive to acid reaction, *p*H 4 5 being very near the limit of acidity at which growth could be induced, a good growth would only take place at *p*H values above 6 0, and an optimum zone seemed to stretch from *p*H 6 6 to *p*H 7 4 and possibly higher In neutral or alkaline solution the fungus exerted a very strong cellulose decomposing activity, in unbuffered physiologically acid solution almost none Its sensitiveness to acidity is greater than that of any fungus hitherto studied in this respect

VIENNA

Academy of Sciences, Oct 16 —E Beutel and A Kutzelnigg (1) Analysis by luminescence —(2) Luminescence of painter's white colours and application of analysis by luminescence to the investigation of paintings —(3) Observations in the alkaline earth group and numerical criteria of luminescence —**A Haas** A relation between the radial velocity of spiral nebulæ and the disintegration velocity of matter —**K Lehnhofer** Deformities in species of *Sapphirina* —**F Halla** Röntgenographic distinction between magnesite and dolomite —**A Deseyve** Secondary corpuscular radiation released from light elements by α rays The disintegration of silicon and phosphorus with α-particles from polonium seems new (See Radium Institute Circular No 267.)—**E Tschermak** (1) New observations on the fertile hybrid *Triticum turgido-villosum* —(2) Xenia in Leguminosæ Several cases of apparent direct action of foreign pollen on colour and form of seeds.—

E Dittler and H. Lasch Synthetic researches on the formation of mixed crystals of barium and strontium felspar with orthoclase —F Raaz The structure of synthetic gehlenite, $2CaO\ Al_2O_3\ SiO_2$

Oct 23 —R Scheu Relations between tensile strength in oscillation by bending and by twisting —M Beier Zoological expedition to the Ionian Islands and the Peloponnesus (14) The slugs treated by H Wagner —K Gödel Some mathematical results on definiteness of decision and freedom from contradiction

Official Publications Received.

BRITISH.

Borough of Cheltenham Public Library Art Gallery and Museum Forty-sixth Annual Report of the Public Library Committee and the Thirty first Annual Report of the Art Gallery and Museum Committee 1st April 1929 to 31st March 1930 Pp. 24 (Cheltenham)

Union of South Africa Department of Mines and Industries Geological Survey Memoir No 12 Asbestos in the Union of South Africa By Dr A L Hall Pp 324+37 plates (Pretoria Government Printer) 7s 6d

South Australia Department of Mines Mining Review for the Half year ended June 30th 1930 (No 52) Pp 87+6 plates (Adelaide Harrison Weir)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1314 (Ae 457) Some Approximate Solutions of the Boundary Layer Equations By V M Falkner and Sylvia W Skan (T 2937 T 2758) Pp 35+21 plates (London H M Stationery Office) 2s net.

Report of the Meeting of the Ross Institute Industrial Anti Malarial Advisory Committee held in the Council Chamber of the Rubber Growers Association 2 Idol Lane E C 3 on Tuesday December 16th 1930 at 2 15 p m Pp 16. (London The Ross Institute)

Torquay Natural History Society Transactions and Proceedings for the Year 1929 30 Vol 5 Part 4 Pp 259 368 (Torquay)

The Proceedings of the Physical Society Vol 43 Part 1 No 236 January 1 Pp viii+118 (London) 7s net.

Indian Central Cotton Committee Technological Laboratory Technological Bulletin Series B No 10 Studies in the Sampling of Cotton for the Determination of Fibre Properties Part 3 The Size and Reliability of a Satisfactory Sample By Ram Saran Koshal and Dr A James Turner Pp ii+80 (Bombay) 1 rupee

Transactions of the Mining and Geological Institute of India Vol 2 Part 2 November Pp 81 182 (Calcutta) 4 rupees

FOREIGN

Conseil International de Recherches, Union Géodésique et Géophysique Internationale Section d Hydrologie scientifique Bulletin N 5 Reunion du Comité executif de la Section (Geneve 14 avril 1927) Notes et communications Pp 31 Bulletin N 13 Reunions du Comité exécutif de la Section (Paris 4 avril 1928—Séville 4 mai 1929) Notes et communications (1 mars 1930) Pp 40 Bulletin N 14 Rapport de la Commission des glaciers 1930 Pp 58 Bulletin N 15 Note e comunicazioni della Sezione nazionale italiana Pp 148 (Venezia Carl Ferrari)

Ministry of Agriculture Egypt Technical and Scientific Servic (Plant Protection Section) Bulletin No 101 Growth Fluctuations during the Development of Seed Cotton By Dr W Lawrence Balls Pp ii+15+2 plates (Cairo Government Press) 5 P T

Journal of the Faculty of Science Imperial University of Tokyo Section 1 Mathematics Astronomy Physics Chemistry Vol 2 Part 3 Pp 51 72. 0 40 yen Vol 2 Part 4 Pp 73 131 0 90 yen Section 3 Botany Vol 3 Part 1 Pp 484 7 00 yen (Tokyo Maruzen Co Ltd)

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 2 No 12 Décembre Pp 699 724+xxiv (Prague Regia Societas Scientiarum Bohemica)

National Research Council of Japan Report No 4-5 April 1924 March 1926 Pp ii+65 118 Report No 6 7 April 1926-March 1928 Pp iii+119 228 (Tokyo)

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 5 No 6 December Pp. ii+1189 1318 (Washington D C Government Printing Office) 40 cents

CATALOGUES

Radiostol Pp 4 (London The British Drug Houses Ltd)

Watson s Microscope Record No 22 January Pp 28 (London W Watson and Sons Ltd)

Eastman Organic Chemicals List No 22 January Pp 99 (Rochester N Y Eastman Kodak Co)

Diary of Societies.

FRIDAY, FEBRUARY 13

ROYAL ASTRONOMICAL SOCIETY (Annual General Meeting) at 5 —Presidential Addresses by Dr A C D Crommelin on the award of the Gold Medal to Prof W de Sitter and the Jackson Gwilt Medal and Gift to C W Tombaugh

BIOCHEMICAL SOCIETY (at Lister Institute), at 5 —W T J Morgan A Specific Precipitating Polysaccharide from *B dysenteriæ* (Shiga).—L F Hewitt Oxidation Reduction Potentials of Pneumococcus Cultures —B C Guha Investigations on Vitamin B_2.—E Boyland and O Meyerhof Glycogen Synthesis in Muscle Poisoned with Mono iodoacetic Acid —Gladys Bird and P Haas The Cell Wall Constituents of Laminaria. Mannuronic Acid —M G Macfarlane The Influence of Potassium Mono iodoacetate on Fermentation by Yeast Preparations —R Robison and E J King Hexosemonophosphoric Esters —W Robson and J Lamb The Erlenmeyer Synthesis of Amino acids

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH at 5 —Dr D K Henderson Social Psychiatry (Morison Lectures) (3).

ROYAL SOCIETY OF MEDICINE (Clinical Section) at 5 30

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College) at 5 30 —R Ellis Roberts Reality in Life and Literature

MALACOLOGICAL SOCIETY OF LONDON (Annual General Meeting) (at Linnean Society), at 6 —G C Robson Some Problems of Molluscan Evolution (Presidential Address)

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle upon Tyne), at 6 —W C S Wigley Ship Wave Resistance—an Examination and Comparison of the Speeds of Maximum and Minimum Resistance in Practice and in Theory

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Institution of Civil Engineers) at 6 30 —D MacDonald Silver and its Application to Chemical Plant

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON) (at 36 George Street, Manchester), at 7 —D W Sanford The Development of the Piston Valve to improve Steam Distribution

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 7

INSTITUTION OF STRUCTURAL ENGINEERS (Informal Meeting) (at Chamber of Commerce Birmingham) at 7 —S I Horolle and others Discussion on Foundations

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers Club Manchester) at 7 15 —C H Faris The Applications of Electro deposited Metal to Engineering

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section jointly with other Chemical Societies) (at Ca doro Restaurant Glasgow) at 7 30 —Prof G Barger Ergot and Ergotism

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section jointly with Microscopical Society of Wales) (at Cardiff Technical College) at 7 30 —C A Seyler The Microscopy of Coal

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College) at 7 30 —S N Duguid Smoke Abatement and Fuel Economy

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —H C Reid Monolith Foundations

INSTITUTE OF METALS (Sheffield Section) (at Sheffield University), at 7 30 —N C Maples The Applications of High Nickel Nickel Copper Alloys and Pure Nickel in Industry

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) at 8 30 —J H Doggart Recurrent Vascular Keratitis of Unknown Origin —Dr Ross Ford A Case of Retrobulbar Neuritis masked by Chloroiditis and due to Latent Sinusitis

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof F Ll Hopwood Ultrasonics Some Properties of Inaudible Sound

SOCIETY OF DYERS AND COLOURISTS (London Section) —A J Hall Bleaching Dyeing and Finishing Processes and their Effect on Finished Goods

SATURDAY FEBRUARY 14

BRITISH PSYCHOLOGICAL SOCIETY (jointly with Cambridge Psychological Society) (in Psychological Laboratory Cambridge) at 2 45 —Papers by Prof W S Hunter and Dr R S Creed —At 6 —Papers by Prof E D Adrian and Dr J T MacCurdy

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —J Stephens On the Reading and Speaking of Verse (1) On Speaking Verse

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Leicester Museum) at 8 —J A Christian Modern Methods of Sewage Disposal

MONDAY FEBRUARY 16

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4 30 —Dr J Knight Demon Possession in the Light of Modern Research (Dr Schofield Memorial Paper)

ROYAL GEOGRAPHICAL SOCIETY at 5 —Dr L Dudley Stamp Land Utilisation Survey

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in Arts Theatre Liverpool University) at 7 30 —Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture)

INSTITUTE OF METALS (Sheffield Section) (at Sheffield University) at 7 30 —Conjoint Discussion on Refractories for Heating and Melting Furnaces

ROYAL INSTITUTE OF BRITISH ARCHITECTS at 8 —F W Deas The Work of Sir Robert Lorimer

EUGENICS SOCIETY (at Rembrandt Hotel Thurloe Place S W).—Sir J Arthur Thomson Warnings from Nature (Galton Lecture)

TUESDAY FEBRUARY 17

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 —Sir William Bragg Recent Experimental Physics (2) The Sizes of Atoms

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5 15 —D Caradog Jones The Social Survey of Merseyside

ROYAL SOCIETY OF MEDICINE at 5 30 —General Meeting

ZOOLOGICAL SOCIETY OF LONDON at 5 30 —H C Wilkie The Middle Ear of the Horse (*Equus caballus*).—M K Serebrennikov On the Polychromatism and Albinism of the Siberian Squirrels —W S Bristowe (a) A Contribution to the Knowledge of the Spider Fauna of South West Ireland and in particular the Islands off the Coast (b) The Spiders of the Island of Grassholm and some Additions to the Skomer Island List —Dr A D Misra On the Internal Anatomy of the Female Lac Insect, *Laccifer lacca* Ckll (Homoptera Coccidæ).

Royal Photographic Society of Great Britain, at 7.—J. E. Saunders: Who's Who in Two Zoos.

WEDNESDAY, February 18.

Royal Meteorological Society, at 5.—L. J. Sutton: Note on Haboobs. —Prof. S. Chapman and Miss M. Hardman: The Lunar Atmospheric Tide at Ocean Island.—A. C. Best: Horizontal Temperature Differences over Small Distances.—E. Ll. Davies: A Portable Temperature Gradient Indicator.

Royal Microscopical Society (at B.M.A. House, Tavistock Square), at 5.30.—Prof. R. Chambers: The Nature of the Living Cell, with Demonstration by Micro-Dissection, Micro-Injection, and Cinematograph.

Overhead Lines Association (at Institution of Electrical Engineers), at 5.30.—Discussion on Wayleaves.

Institution of Electrical Engineers (London Students' Section), at 6.15.—V. S. Lake, W. F. J. Walton, and others: Discussion on Are the Present Methods of Those Interested in the Supply of Current and Apparatus Conducive to the Spread of Domestic Electrification?

Institution of Automobile Engineers (Manchester Centre) (at Engineers' Club, Manchester), at 7.—E. V. Pannell: Light Alloy Piston Development.

Institution of Electrical Engineers (Tees-side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—S. G. Brown: Loud Speakers since their Conception, with Gramophone Pick-ups and Wireless Recording Apparatus.

Illuminating Engineering Society (at Home Office Industrial Museum, Horseferry Road), at 7.—Discussion on Problems in Illuminating Engineering.—W. J. Jones: The Relation between Intensity of Illumination and Visual Capacity.—J. H. Parker: The Lighting of the Kingsway Tunnel.—O. P. Bernard: Lighting at the International Exhibition of Persian Art.—H. H. Long: Lighting for Furniture Spraying.—H. R. L. Goring: A Problem in Cathedral Lighting.—R. A. Ives: A Problem in Flood Lighting.

Institution of Automobile Engineers (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—Dr. W. H. Hatfield: Rustless Steels as applied to Automobiles and Aircraft.

North East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—D. Tagg: The Utilisation of Waste Heat in Oil Engine Installations.

Institution of Electrical Engineers (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—C. C. Paterson: Address.

Royal Society of Arts, at 8.—G. H. Jack: The Art of the Bridge Builder.

Royal Society of Medicine, at 9.15.—Dr. H. L. Tidy: Poisoners of Ancient Times.

THURSDAY, February 19.

Royal Society, at 4.30.—Prof. A. J. Allmand and L. J. Burrage: The Discontinuous Nature of the Process of Sorption of Gases and Vapours by Porous Solids.—C. H. Collie: The Decay Constant of Uranium II.—*Papers to be read in title only*:—Prof. L. N. G. Filon and F. C. Harris: The Photo-Elastic Dispersion of Vitreous Silica.—G. B. Deodhar: Some Investigations in Röntgen Spectra.—J. G. A. Griffiths and Dr. R. W. G. Norrish: The Photosensitised Decomposition of Nitrogen Tetrachloride.—Prof. S. Chapman and J. M. Stagg: On the Variability of the Quiet-Day Diurnal Magnetic Variations. II.—A. Thom and J. Orr: The Solution of the Torsion Problem for Circular Shafts of Varying Radius.—Prof. C. G. Darwin: Examples of the Uncertainty Principle.—E. C. Bullard and H. S. W. Massey: The Elastic Scattering of Slow Electrons in Argon.—V. C. G. Trew and J. F. Spencer: The Magnetic Susceptibility of Binary Systems of Organic Liquids.—W. G. Kannuluik: On the Thermal Conductivity of Some Metal Wires.—Prof. P. Kapitza: The Study of the Magnetic Properties of Matter in Strong Magnetic Fields. I., II.

Linnean Society of London, at 5.—V. S. Summerhayes: The Angiospermic Flora of the Seychelles Archipelago.—J. Ramsbottom: The 'Proceedings' of the Society of Amateur Botanists.

Royal Institution of Great Britain, at 5.15.—Prof. J. B. S. Haldane: Respiration (1).

Society of Chemical Industry (Edinburgh and East of Scotland Section) (Annual General Meeting) (jointly with Local Section of Institute of Chemistry) (at North British Station Hotel, Edinburgh), at 7.30.—C. Parkinson: Lithographic Processes and Problems.

Society of Chemical Industry (Nottingham Section, jointly with Institute of Fuel) (at University College, Nottingham), at 7.30.—J. L. Strevens: Petrographic Treatment of Coal; the Mechanical Separation of Coal into its Constituents and their Commercial Applications.

Leicester Literary and Philosophical Society (Botany and Biology Section) (at Leicester Museum), at 7.30.—P. A. H. Muschamp: The Blue Butterfly.

Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.

Chemical Society, at 8.—F. Challenger and B. Parker: A New Method for the Preparation of Organo-thallium Halides.—W. F. K. Wynne-Jones: The Dissociation of Salts in Nitrobenzene.—D. R. Pryde and F. G. Soper: (*a*) The Formation of Acyl chloroamines from Hypochlorous Acid; (*b*) The Direct Interchange of Chlorine in the Interaction of p-toluenesulphonamide and N-chloroacetanilide.

British Institute of Radiology (at 32 Welbeck Street), at 8.30.—A Radium Symposium.—C. E. S. Phillips: Note on the Preparation of Radium Salts for Therapeutic Use.—Prof. E. N. da C. Andrade: A Model to Illustrate the Passage of an Alpha Particle in the Neighbourhood of an Atomic Nucleus.—Dr. W. Roy Ward: Some Aspects of Radium Therapy.—Dr. A. Burrows: The Organisation of the Radium and X-Ray Cancer Service in Australia.

Royal Aeronautical Society (Gloucester and Cheltenham Branch).—A. L. Williams: Heat Treatment of Steels.

Royal Aeronautical Society (Yeovil Branch).—Squadron Leader R. B. Borley: Lay-out and Equipment of Service Aircraft.

FRIDAY, February 20.

Association of Economic Biologists (Annual General Meeting) (in Botany Department Lecture Room, Imperial College of Science and Technology), at 11.30 A.M.—Discussion on Biological Races and their Significance in Evolution, to be opened by the President. Other speakers:—Dr. W. B. Brierley (Fungi), Dr. P. Bruce White (Bacteria), Dr. T. Goodey (Nematodes), Dr. W. H. Thorpe (Insects), Dr. W. B. Turrill (Seed-Bearing Plants).

Geological Society of London (Annual General Meeting), at 3.—Prof. E. J. Garwood: Presidential Address.

Physical Society (at Imperial College of Science and Technology), at 5.—G. G. Sherratt and J. H. Awbery: On the Velocity of Sound Waves in a Tube.—P. S. H. Henry: The Tube Effect in Sound-velocity Measurements.—W. A. Wood: Note on the Elimination of the β-wave-length from the Characteristic Radiation of Iron.

British Institute of Radiology (Medical Meeting) (at 32 Welbeck Street), at 5.—Dr. H. Cohen and Dr. P. H. Whitaker: Cinematograph of Ventriculography.—Dr. R. E. Roberts: (*a*) Lympho-sarcoma Involving the Stomach; (*b*) Carcinoma of Lung with Pathological Specimens.—Dr. J. H. Mather: X-Rays of a Case of Idiopathic Myositis Ossificans 1896 and 1930.—Dr. H. K. Graham Hodgson: Demonstration of the Technique of Method of Sinus Investigation.—C. T. Holland: Radiographs of Unique Conditions.

Society of Chemical Industry (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6.—L. Wild: Modern Developments in Printing.

Institution of Mechanical Engineers (Annual General Meeting), at 6.—Capt. A. Swan and others: Investigation of Steels for Aircraft Engine Valve Springs.

Society of Dyers and Colourists (at Manchester Literary and Philosophical Society), at 7.—J. S. Wilson: Solazol Dyestuffs.

Royal Photographic Society of Great Britain (Pictorial Group), at 7.—Informal Meeting.

Society of Chemical Industry (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. S. R. Illingworth: Some Aspects of the Carbonisation of Coal.

Junior Institution of Engineers (at Royal United Services Institution), at 7.30.—A. J. Grant: The Construction of the Variable Density Tunnel for the National Physical Laboratory at Teddington.

Shipley Textile Society (at Shipley Technical School), at 7.30.—A. B. Shearer: Rayon: Its Uses in Woven Fabrics.

Royal Society of Medicine (Electro-Therapeutics Section), at 8.30.

Royal Institution of Great Britain, at 9.—Prof. J. B. S. Haldane: Prehistory in the Light of Genetics.

Geologists' Association (North East Lancashire Group) (at Technical College, Blackburn).—W. L. Turner: With the Geologists' Association in Czechoslovakia (Lecture).

Rochdale Textile Society (at Technical Schools, Rochdale).—Gregg: Modern Weaving Methods.

SATURDAY, February 21.

North of England Institute of Mining and Mechanical Engineers, at 2.30.

Royal Institution of Great Britain, at 3.—J. Stephens: On the Reading and Speaking of Verse (2): Difficult Poets.

PUBLIC LECTURES.

SATURDAY, February 14.

Horniman Museum (Forest Hill), at 3.30.—Major G. M. Coombs: Fiji and the Fijians.

MONDAY, February 16.

London School of Hygiene and Tropical Medicine (Public Health Division), at 5.—Col. L. W. Harrison: Venereal Disease Schemes.

TUESDAY, February 17.

University College Hospital Medical School, at 5.15.—Dr. Janet Vaughan: The Pathology and Treatment of Pernicious Anæmia. (Succeeding Lecture on Feb. 24.)

Gresham College, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Feb. 18, 19, and 20.)

WEDNESDAY, February 18.

London School of Hygiene and Tropical Medicine (Public Health Division), at 5.—Col. L. W. Harrison: Venereal Disease Treatment Centres.

King's College, London, at 5.30.—H. J. Wood: The Great Age of Discovery: The Search for a Western Passage.

Belfast Museum and Art Gallery, at 8.—Prof. Gregg Wilson: The Story of a Fish.

FRIDAY, February 20.

Institution of Professional Civil Servants (at Chartered Surveyors' Institution), at 5.30.—T. Wilson: Westminster, its Palaces and Parliaments.

SATURDAY, February 21.

Horniman Museum (Forest Hill), at 3.30.—R. W. Sloley: Water-Clocks and Sun Dials.

EXHIBITION.

Tuesday, February 17, till end of April.

Exhibition of the Mineral Resources of the Empire (at Imperial Institute).

Thursday, Feb. 19, at 5.30.

Sir Robert Horne: The Mineral Resources of the Empire (Address).

SATURDAY, FEBRUARY 21, 1931

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Work of the Forestry Commission. Progress and Promise *

I

THE Forestry Commission of Great Britain came into being as the result of the Forestry Act of 1919 Under the financial section of that Act, a sum of 3½ million pounds was to be provided for the first ten years of the Commission's work, the money to be voted annually by Parliament in instalments up to the total sum sanctioned for the period

The Forestry Act was based to a great extent on the advice tendered by the Acland Committee, which reported in May 1917 The Act, quite correctly as many think, did not, however, embody in its clauses the recommendations of the Committee that a hard and fast annual planting programme should be adhered to, coupled with an attempt to procure land, by purchase or otherwise, on a scale sufficient to keep pace with a planting programme laid down in advance In their review of the ten years' work, the Commissioners can state, and they do so with perhaps pardonable pride, that the two objects have been very nearly achieved, in spite of the set-back which many Government departments experienced when the 'Geddes axe' (1922) was being wielded over Whitehall Even in the case of such a department as 'Forests', a profession of the open air, we find that in 1929–30 the technical staff numbered 70, whilst clerical staff numbered 100! Unexpected difficulties also were encountered in obtaining the land required, especially in the north, and the mildest criticism on some of the areas obtained has been that the value of the forest crop they are likely to grow is problematical

Every annual report since 1923 has referred to this 'Geddes axe' contretemps in the history of the work of the Forestry Commission But to many practical foresters possessing administrative experience, the view and attitude so taken appear to be somewhat distorted It is a well accepted factor in forestry economics that any slump in trade in a country, or part of a country, will be immediately reflected in forestry revenue and returns, either of the country as a whole or in the part of the country affected, and forest officials are well aware that they will experience cuts in the expenditure side of their next forest budgets

In the case of the Forestry Commission, it is held by a not inconsiderable section of expert opinion in Great Britain that it was, and is, a mistake to tie

* Forestry Commission Tenth Annual Report of the Forestry Commissioners year ending Sept 30, 1929 Pp 69 (London H M Stationery Office, 1930) 1s 3d net

the forestry business to an annual programme of planting laid down in advance—and consequently to the necessity of endeavouring to acquire land for the purpose to at least a fixed annual amount With the finances of the country in their present position, not even the keenest supporter of afforestation in Great Britain would agree to the sacredness of either the 1929–38 planting programme or its more or less prescribed land acquisition plan

It must be admitted that the Forestry Commission deserves congratulation on its ten years' work It may be suggested, however, that the Commissioners will be well advised not to pin their faith on adhering to a hard and fast policy of *annual* planting and land acquisition, by area A clear-sighted forest administration knows full well that it has to 'cut its coat according to its cloth' Should retrenchment have to come during the present ten years, the Commissioners have now in hand a forest area of considerable size, which doubtless can provide plenty of work for the existing staff, and no one expects the present forest estate, consisting for the major part of young plantations, to show a profit for years to come—so that worry has not to be faced

It will be readily conceded, as the writer of the review in the report before us says—" The object of the ten year programme was to avoid uncertainty Uncertainty is the worst enemy of the Commissioners' work " Every forester should know that success in forestry depends upon continuity in working What, however, is not so readily appreciated is that this well recognised axiom applies to forest departments which have under their charge considerable areas of existing revenue-yielding forests Here interruptions in continuity of working result in serious losses in revenue and check the due expansion and progress of forest management Great Britain is not in such a position Therefore it would be difficult to support, on economic grounds, the necessity for adhering to a hard and fast annual planting plan, though it may be a perfectly sound policy to prepare such a scheme and endeavour to work up to it So far, the Commission has made a fetish of this branch of forest work—at the expense of reafforesting areas felled during the War, which had at least one forestry asset, an established forest soil

The work carried out under the auspices of the Commissioners up to the end of the growing season of 1929 may be briefly summarised as follows Of plantable land, 310,230 acres were acquired, of this area, 130,768 acres were planted with conifers and 7511 acres with hardwoods State-aided planting (that is, by making money grants to private proprietors) was responsible for another 76,736 acres planted The original programme did not envisage the creation of forest workers' holdings As one outcome of the unemployment question this matter was taken up in 1924 and received a warm acceptance by the Government officials concerned, the result was that 618 holdings were completed by the end of the ten year period and another 245 were in progress Wherever possible, existing buildings have been converted for the purpose of the holdings But in many cases new buildings have had to be erected and the work has proved somewhat costly However, in the case of the forest workers' holdings, there are a good many questions of an economic nature to be weighed, apart from the purely financial one So far as can be foreseen at the present time and under existing social conditions, the forest workers' holdings can be regarded as a sound departure

At the end of September 1930 the Forestry Commission had under its charge 602,000 acres of land, of which 251,000 acres had been acquired by purchase, 231,000 acres by long lease or feu, and the balance, approximately 120,000 acres, consisting of Crown Woods, had been transferred to the Commissioners under the Transfer of Woods Act of 1923 The following extract from the report will indicate that sound views now prevail on the subject of land acquisition

"In acquiring land the Commissioners have kept constantly in view their main functions, which are to establish forests and forest workers' holdings The acquisition of assets surplus to those requirements has been avoided so far as possible, and where it has been necessary to acquire surplus assets in order to build up desirable forest properties the policy is to dispose of them as rapidly as sound business permits "

The activities of the Commissioners in the direction of forest education and research work are discussed at length Expert opinion in Great Britain is by no means agreed either as to the value of some of the Commission's activities in these directions or the soundness of some of the advice given by the Commissioners References have already been made to such matters in our columns, the points in question, moreover, are well known to those interested in these matters throughout the country and need no further emphasis here

Weighed dispassionately, however, the consensus of opinion will be that the Commissioners in the work of the past ten years have deserved well of their country and have earned the thanks of their countrymen The chairmen have been Lord Lovat,

one of the originators of the scheme (1919–27), Lord Clinton (1927 to 1929, end of ten-year period), Sir John Stirling Maxwell, the present chairman Mr R L Robinson has been the Technical Commissioner throughout the period

The summary of the ten years' work is unfortunately drawn up on the most approved Whitehall lines It bristles with statistics and tabular statements, resembling a report emanating from the Treasury or Board of Trade From the point of view of the public the report is useless Several of the reports of forestry departments issued in other parts of the Empire are nowadays human documents, often illustrated The Commissioners have missed a great opportunity for propaganda to interest the public, whilst they would have set an example which might have had the beneficial result of brightening up Whitehall reports and Blue Books generally

Concepts of Social Biology

The Biological Basis of Human Nature By Prof H S Jennings Pp xviii + 384 (London Faber and Faber, Ltd, 1930) 15s net

ALMOST everything which has been written on the biological foundations of human society is based upon a false antithesis with a historical background, which should be evident to everyone who is familiar with the progress of animal biology during the last century Before the emergence of the cell doctrine during the 'thirties, Kölliker's discovery that the sperm is produced by the transformation of a single cell in the testis of the male parent, and the elucidation of the phenomenon of fertilisation by Fol in 1879, the prevailing biological concept of inheritance was very much like the legal one While the egg was still regarded as an adult in miniature, it was natural to think that we pass on our noses in much the same way as we pass on our mortgages When the essential features of fertilisation were established, it was natural that biologists should challenge the legal view of inheritance associated by custom with the name of Lamarck Had Weissmann confined himself to this modest task, his influence on biological theory would have been one of permanent usefulness Unfortunately, he could not stop at that From a total misconception of the rôle of the external environment in relation to the materials of inheritance, biological doctrine swung over to a total neglect of the rôle of environment in the process of development

Weissmann's conception of development, elaborated in association with Roux, reduced the external medium to a perfect vacuum As in Stevenson's fable, the gyves were firmly riveted on the left leg before the ulcer on the right had healed To-day the progress of experimental embryology has relegated Weissmann's theory of development and the hypothesis of germinal selection to the same limbo as the Lamarckian doctrine In animal biology, heredity and environment are used as classifications of two types of variables which interact at every stage of development, to produce at the end of the process one of a large number of possibilities called an individual Heredity includes the class of variables which can be defined in terms of the material of which the sperm and egg are respectively composed Environment includes that whole class of variables which are significant in the further development of the fertilised egg A difference between two animals may be predominantly a genetic or predominantly an environmental one To speak of characters as hereditary or environmental, innate or acquired, is, strictly speaking, meaningless

In animal biology these are commonplaces Unfortunately, in human affairs they are still startling and almost revolutionary ideas The main concern of Prof Jennings in "The Biological Basis of Human Nature" is to see that they shall become commonplace in social biology He has performed this signal service with the lucidity, good humour, and terseness which have enhanced his reputation as one of the most penetrating and provocative thinkers in contemporary biology "A burden of concepts and definitions", he says, "has come down from pre existing days, the pouring of the new wine of experimental knowledge into these has resulted in confusion And this confusion is worse confounded by the strange and strong propensity of workers in heredity to flout and deny and despise the observations of the workers in environmental action, the equally strange and strong propensity of students of environmental effects to flout and despise the work on inheritance" On behalf of the workers on heredity, it may be pointed out that extravagant dogmatism concerning the hereditary significance of human differences is less common among biologists than among statisticians, retired majors, and clergymen with journalistic propensities The leading geneticists, and among them first and foremost T H Morgan himself, have usually shown extreme reserve in discussing the genetic aspect of social behaviour

"The Biological Basis of Human Nature" does not set out to be a comprehensive text-book of

social biology It is the prolegomena to any genuinely biological analysis of human society The *Corpus errorum biologicorum* in Chap ix should be read by everyone who has an interest in the relation of biological concepts to social science Throughout the book Prof Jennings emphasises the need for detachment and scepticism in approaching what is still a virgin field of inquiry He discusses the possibilities of eugenic measures with a moderation and sanity which will compel the sympathy of many previously alienated by the manifest political bias or ludicrous exaggerations of propagandists determined to damage their own case Having stressed the extreme difficulty of analysing social differences to which several gene mutations make a contribution, he states

"We must know more as to what human troubles are due to definite single-pair gene defects These are the defects with which eugenic measures can effectively deal, and as yet but a small number of them are positively known The great difficulty about this is that bad living conditions often produce the same kind of results that bad genes do Persons may become idle and worthless, insane or criminal or tuberculous—either through bad genes or through bad living conditions, or through a combination of both So long as living conditions are bad, we do not know what ills are due to bad genes We must therefore correct the bad living conditions, not only for their directly beneficial effect, but also for the sake of eugenics When this is done, it will be possible to discover what defects are primarily the result of defective genes, and then to plan measures for getting rid of these genes measures for stopping the propagation of their carriers"

In the chapter on race mixture and its consequences the author maintains the balance between two conflicting sources of bias with judicious restraint in most of the conclusions he states The reviewer is of the opinion that he attaches too much importance to the conclusions stated by Davenport and Steggerda at the conclusion of their monograph on "Race Crossing in Jamaica", and too little weight to the actual data contained in the text Indeed, he himself departs from the high standard he has set elsewhere, when he states that the blacks "showed superiority in Mental Arithmetic and in following complicated directions for doing things On the other hand, the Whites showed a distinct superiority in the tests of intellectual ability" In the Army Alpha tests the blacks excelled in one half and the whites in the others The former category included all the numerical tests—simple or otherwise It is not clear why the verbal tests should be classified as 'intellectual' in contradistinction to the numerical tests Few biologists seem to be aware that the most recent investigations on the I Q of foster children and twins show how little justification there is for the belief that such tests distinguish differences which are of genetic and extrinsic origin The implications of Spearman's work alone necessitate a very sceptical attitude to earlier views concerning the genetic status of psychological tests

Those who are familiar with "Prometheus" will not be surprised to find that Prof Jennings stresses the need of recognising that man has a natural history of his own In the last chapter he attributes the neglect of the specifically human characteristics of human behaviour to the mechanistic tradition in the philosophy of the organism, and favours the emergent point of view as a more sympathetic setting for a humanism which draws its inspiration from biological knowledge His statement of the emergent point of view is so carefully pruned that most biologists with a mechanistic bias will find it difficult to realise why Prof Jennings goes to so much trouble to identify his own clear and unexceptionable views with what has now become a label for various species of contemporary philosophical obscurantism It is doubtful whether the disposition to interpret the entire panorama of human history within the framework of our present biological hypotheses is generally associated with an explicitly materialistic bias in philosophy or a partiality for physico-chemical interpretations of vital phenomena A consistent mechanist will be the first to recognise that the biology of Darwin's generation was neither sufficiently adequate to undertake an analysis of the structure of human society, nor even equipped to state, as we now can state, the fundamental requirements of the problem in biologically significant terms The assumption that human nature is the product of heredity and environment owes its plausibility to the mechanistic point of view and this assumption is accepted as axiomatic throughout Prof Jennings' book

An Introduction to Plato

The Growth of Plato's Ideal Theory an Essay By Sir James George Frazer Pp xi + 114 (London Macmillan and Co, Ltd, 1930) 7s 6d net

THE little book before us is far the best introduction to the study of Plato which we know, and every reader will be grateful to Sir James Frazer for rescuing it from his pigeon-holes. It was written fifty years ago as a dissertation for

fellowship at Trinity, and has therefore all the harm of youthful enthusiasm and newly acquired nowledge This more than compensates for any orrections necessary in minor points—the dating of the dialogues and so forth It is one of the book's outstanding merits Another is that, taking one thread—the development of the ideal theory—as the clue, it is possible to connect all the dialogues by their most vital link and give both unity and evolution to the picture without overloading it with details

The last, and to a scientific reader the most weighty, merit is that the author, while enjoying Plato to the utmost as a writer, a dramatist, and a poet, is under no illusions as to the fundamental fallacies of the Platonic ideas The criticism, based on a simple but very careful examination of the language of Plato himself, establishes the fact that the ideal theory arose from the questioning of Socrates as to the nature of general ideas, especially of a moral kind, was then elaborated into an ontological construction in a middle period, represented chiefly in the "Phaedo" and the "Republic", and was dispersed, by virtue of its own contradictions and a strong admixture of Pythagoreanism, in the last period, represented by the "Timaeus", the "Sophist", and the "Parmenides"

It is this sketch of the whole series of the dialogues, linked up by the ideal theory, which gives the book its high interest and value By slight enlargement here and there it can be regarded not only as an introduction to Plato but also as a picture of the nature and development of Greek philosophic thinking as a whole One point on which Sir James Frazer is most emphatic throws a flood of light on the subsequent history of Platonic idealism and its influence on Christian and modern thought He makes it abundantly clear that Plato never contemplated an idea of evil or evil things The model which was laid up in heaven was of heavenly things, and was at every stage permeated by the notion of perfection in the moral rather than the logical sense Its connexion on these lines with Christian theology is obvious, and it brings us direct to the modern conception of 'values'

On the other side the author has little trouble in making the true and obvious connexion with the weakness of Greek scientific thinking as a whole, in jumping precipitately from the contradictions of sense to an ideal unity or cause lying behind them This, Plato, in common with most Greek thinkers, was ready to find in an abstract construction of the mind The mind of the thinker, thus set to work by the impact of sense impressions, then proceeded to work untrammelled in its interior isolation, and produced a result eminently satisfactory to the inward eye but certain to be shattered so soon as later observation confronted it with obstinate fact This intently abstract and mental quality of Greek thinking accounts for their brilliant contributions to mathematics and their comparative failure to build up any efficient system of laws in the actual physical universe of which we are a part The analogy of certain modern mathematical thinkers whose work is noticed from time to time in these pages immediately comes to the mind F S MARVIN

Virus Diseases and the Bacteriophage

Medical Research Council A System of Bacteriology in relation to Medicine Vol 7 By C H Andrewes, J A Arkwright, S P Bedson, F R Blaxall, F M Burnet, J Burton Cleland, A Felix, G Marshall Findlay, W Fletcher, I A Galloway, M H Gordon, J G Greenfield, W E Gye, W F Harvey, E Hindle, P P Laidlaw, J C G Ledingham, R J Ludford, J E McCartney, J McIntosh, A G McKendrick, H B Maitland, M S Mayou, R St John-Brooks, J Henderson Smith, A Theiler, C Todd, J Walker Pp 509 (London H M Stationery Office, 1930) 21*s* net

THIS volume deals wholly with virus diseases and the bacteriophage A review of it is somewhat difficult because divergent opinions exist regarding these viruses and the diseases they produce, and much of the information is necessarily uncertain and based on somewhat feeble foundations At the same time, the interest in the subject is widespread, and it is well to have collected the main facts and theories into one volume

There is necessarily a considerable amount of irregularity in the merits of the various articles Some of these are written by men who have themselves an intimate knowledge of the subjects they deal with, while others are mere compilations from the work of others, and sometimes one asks why this special author has been chosen when others with practical experience of the diseases described could be found One always sympathises with an editor who has to find someone to do the work when the man who ought to do it has refused, and this may possibly be the explanation of the choice in some of the cases

The introductory survey in Chap. 1, by Gye and Ledingham, and the chapter on cell inclusions are well written and give all the essential facts for those

who propose studying these diseases, but they also discuss and criticise the theories that have been suggested, and this method of dealing with the subject is both interesting and helpful to the reader

The illustrations in Chap ii will be welcomed, though we think that clearness would have been gained if some colour had been used

Chap v, on foot-and mouth disease, gives an excellent account of the work on this subject up-to-date, though one misses any reference to the now proved spontaneous outbreak in rats, established quite clearly by the Ministry of Agriculture Though this article is well written, we think some parts of it might have been improved by the association with the author of someone with wider knowledge of the veterinary aspect of the disease The chapter on smallpox is excellent, and written in a truly critical way by a man evidently thoroughly familiar with his subject

Among the other outstanding chapters are those on encephalitis lethargica and acute poliomyelitis, by Prof McIntosh, dog distemper, by Dr Laidlaw, pleuro-pneumonia of bovines, by Walker, and typhus fever, by Arkwright and Felix Though we may not agree with all the statements in these chapters, yet the facts are extremely well put, and the case for the conclusions strongly supported by evidence largely obtained by personal practical work by the authors Virus disease work will no doubt produce many facts in the future which may bring about considerable changes in our present views, but the work in these chapters will largely remain as fundamental

Yellow fever is a disease which has led to much controversy, but in Chap xxxviii Hindle has put the present position clearly and has given a well-considered account of the disease and its virus The bacteriophage, even a more controversial subject, has been well and adequately treated by Dr Burnet

The virus diseases of plants and of insects have also been dealt with There is a short but interesting chapter on acute disseminated encephalomyelitis and its relation to vaccinia, measles, etc, by Dr Greenfield, which is well worth attention In view of much recent work, the chapters on herpes and varicella are of value Rabies is very fully dealt with by Harvey and McKendrick, and the chapter on measles is also worthy of careful study

Of the rest of the volume little need be said Those who are interested in such animal diseases as fowl plague, fowl pox, cattle plague, swine fever, etc, will find most of the information on the bacteriology of these diseases in various chapters, and practically all the diseases attributed to viruses are included Most of these chapters are interesting, though many of them are mere compilations from papers by various authors The advisability of having included some of them, considering the present uncertainty of our knowledge, is at least questionable, unless we are to have revised editions at frequent intervals Even since some of the articles have been written, new information has been gained which might modify some of the views propounded To take one example, we find no mention of the work on psittacosis

Considering our lack of knowledge of the nature of the viruses, and the mass of literature—much of it undigested and contradictory—which has, within recent years, found its way into the journals, we congratulate the authors, as a whole, on the completion of what must have been a somewhat difficult task They have produced a volume which will prove very helpful to all workers on the subject, and will prove to be not the least valuable of the volumes already issued J M BEATTIE

Early Beliefs

(1) *Ghosts and Spirits in the Ancient World* By Dr E J Dingwall (Psyche Miniatures General Series No 28) Pp 124 (London Kegan Paul and Co, Ltd, 1930) 2s 6d net

(2) *Possession, Demoniacal and other among Primitive Races, in Antiquity, the Middle Ages, and Modern Times* By Prof T K. Oesterreich Authorised translation by D Ibberson Pp xi+400 (London Kegan Paul and Co, Ltd, 1930) 21s net

(3) *Animism, Magic and the Divine King* By Dr Géza Róheim Pp xviii+390 (London Kegan Paul and Co, Ltd, 1930) 21s net

INTEREST in what the second-hand booksellers' catalogues call 'the occult' is perennial Here, if anywhere, is common meeting-ground for civilisations widely apart in time and space The mascot is the fetish reborn spiritualism and the cult of the dead are at one in their belief in the near presence of those who have 'passed over', and their concepts of the spirit-world might well be regarded as interchangeable

Both Dr Dingwall and Prof Oesterreich suggest this reflection, the one specifically, the other by implication The former points out that many early records of apparitions might have been written almost word for word to describe phenomena of

modern spiritualism. the latter places the data of possession among primitive races side by side with descriptions of the consciously induced states of the medium

(1) Dr Dingwall writes from the viewpoint of a scientific historian He gives an account of the means employed in ancient times—in Egypt, Mesopotamia, among the Hebrews, and in the classical world—in order to make effective the belief in the existence of spirits, good and bad Such, for example, are divination and other magical practices The use of the waxen image, familiar in modern witchcraft, goes back to ancient Egypt Dr Dingwall also recalls some of the well known cases of apparitions in Greek and Roman literature, as well as the remarkable spiritistic phenomena from ancient China Chinese records of clairvoyance and telepathy, telekinesis, poltergeists, spirit-writing, and so forth, afford a remarkable parallel with the performances of the modern medium The real problem is, however, how far these records may be regarded as constituting evidence which bears upon the quest of modern psychical research Is there behind these stories, asks Dr Dingwall, something which we are not yet in a position to explain?

Dr Dingwall's conclusion is cautious, but he does hold finally that the records throughout the ages show that there have been manifestations which, after making allowances for fraud and delusion, point to something which is still unexplained and offers a field for research on strictly defined scientific lines

(2) Prof Oesterreich's treatise is a translation of a work which first appeared in German so long ago as 1921 It may be mentioned here as the direct antithesis to Dr Dingwall's method of attacking the problem Prof Oesterreich's wide survey of the phenomena of possession among primitive races, in antiquity and in modern times, deals with the subject on psychological lines as the manifestation of an abnormality, whether automatic or induced A translation of this work is very welcome, especially as its free use of verbatim quotation makes it a mine of information for the student

(3) Dr Róheim's work is a re-examination of early forms of belief and ritual, especially those conceptions relating to magic and fertility with which "The Golden Bough" has made us familiar They are here translated into a whole-hearted sexual symbolism. In this extreme form the argument will scarcely convince anyone but an already fervent disciple of Freudian psychology.

Our Bookshelf

Handbook of Chemical Microscopy By Prof Émile Monnin Chamot and Prof Clyde Walter Mason. Vol 1 *Principles and Use of Microscopes and Accessories, Physical Methods for the Study of Chemical Problems* Pp xiii+474 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 22*s* 6*d* net

Although the microscope has now become firmly established in the chemical laboratory, the average chemist is none too familiar with the instrument, and its possibilities are likely to be under-estimated This volume offers to research worker, analyst, or technical chemist a useful compendium of microscopic technique, together with a clear explanation of the theory of the microscope, an understanding of which is essential for trustworthy and accurate work, especially at the higher magnifications The various methods of illumination are set out, and their effects on resolution and contrast well explained

Short sections devoted to ultra-microscopy, photomicrography, and the quantitative analysis of mixtures by microscopic methods dependent on counting or measurement will offer little fresh to the specialist, but should greatly assist the worker in another field, especially as there are adequate literature references

One of the most valuable uses of the microscope to the chemist is in the determination of the optical properties of crystalline material for determinative or research purposes, and here the treatment appears somewhat cramped The average chemist knows little of optics and less of crystallography, and so short a summary of crystal optics is likely to deter rather than to encourage him to refer to one of the text books on this subject The bibliography, too, is inadequate in this direction—a most disappointing perpetuation of the neglect of this field Much space is devoted to the description of microscopes and accessories, this is a useful feature, but, unfortunately, dealt with almost exclusively from an American point of view M H H

The Economics of Forestry By W E Hiley (Oxford Manuals of Forestry) Pp xiv+256 (Oxford Clarendon Press, London Oxford University Press, 1930) 21*s* net

This book, the author states, is founded upon courses of lectures given in the Oxford School of Forestry and the Imperial Forestry Institute The treatment of the subject differs from that followed by Schlich in his well known "Forestry Manual", which has been used by generations of British-trained foresters It is not at first sight easy to follow the author in his methods The first part of the book is devoted to timber supplies, consumption, and prices, compiled from trade statistics in several parts of the world, and from other authors In Part II Hiley treats of finance and its importance But it differs from Schlich's well-known "Valuation and Management" (vol 3) in that Hiley has jettisoned most of the accepted formulæ of 'forest valuation' The author admits that

some of the formulæ omitted may in the future prove useful If this is the case, the student should be made acquainted with them

Formulæ are not the only omissions The author writes "I have said nothing about the selection system of forest management, because I have been unable to find any reliable data on which to estimate profitableness under this system" A very large proportion of the forests of the British Empire are managed on some form of selection system, and must continue to be so managed for a long time to come Further, Hiley states that the financial aspects of forestry have not received in the past sufficient notice, "since the care for forestry has been based on the objective of general human welfare rather than financial gain, and emphasis has been placed on the indirect benefits which forest maintenance often confers" In many of the forests of the British Isles the indirect benefits outweigh the direct financial ones, and a text-book should place the two aspects before the student There are many good things in this book, but the omissions appear serious

Electrical Power Transmission and Interconnexion By C Dannatt and J W Dalgleish (The Specialists' Series) Pp xi + 424 (London Sir Isaac Pitman and Sons, Ltd, 1930) 30s net

The transmission of electrical energy has now become a very important engineering problem It is not surprising, therefore, that the literature on the subject is increasing very rapidly The expert finds a difficulty in keeping abreast of the advancing tide of knowledge Consequently, there is room for a book which describes the latest developments in the theory of transmission This book is written by two capable engineers, and it is interesting to notice how they have collected, from the advanced treatises and papers they have studied, the theorems which have great practical value whether they are easy to understand or not On p 11, for example, we come across Maxwell's coefficients of capacity and potential The schoolmaster in us objects, however, to such statements as "It will be obvious that $p_{12} = p_{21}$" This kind of assertion we come across in examination papers In these cases we take it to mean that the examinee does not see it himself but hopes that it is obvious to the examiner

What pleases us most about the book is that it is thoroughly up-to-date, and that only really important practical theorems are given There are some defects in methods of proof, but in no case, so far as we have noticed, is the defect serious We confess to feeling annoyed every time we come across Kirchhoff's name spelt with only one *h* One of the most valuable chapters in the book is on the relative value of earthing as compared with insulating overhead high tension networks In Great Britain we generally use solidly earthed neutrals In Germany they are earthed through Petersen coils, so called after their inventor, Prof Petersen, of Darmstadt At the present time, there is scarcely sufficient operating experience available to determine which system is the best, but the authors state the problem clearly

Dictionary of Biological Equivalents German-English By Ernst Artschwager. Pp 239 (6 plates) (London Baillière, Tindall and Cox, 1930) 20s net

In 1921, Dr Ernst Artschwager and Edwina M Smiley published a small "Dictionary of Botanical Equivalents", which was concerned with accurate translations of French-English, German-English terms employed in botanical science Now Dr Artschwager has prepared another dictionary of German-English equivalents embracing the wide field of terms employed in biological science Owing to the extreme specialisation in biology which, as the author points out in his preface, "has increasingly narrowed the working sphere of the individual", the need for accurate, easily found translations of the technical terms employed is obvious, since every worker must needs keep abreast with related aspects of his own branch of natural science

The book contains lists of abbreviations used, the common German abbreviations, irregular verbs, metrical equivalents, references used in compilation, as well as the dictionary itself At the end of the book are six plates dealing with the morphology of plants and animals, which enable the reader to see at a glance the required equivalent, since the drawings are numbered and the key faces the illustrations Dr Artschwager is to be congratulated on producing a book so comprehensive in scope, and the publishers on the clear printing The book is strongly recommended to those who have little knowledge of German technical terms which are employed in the various aspects of biological science

The Structure and Meaning of Psycho-analysis as related to Personality and Behavior By Dr William Healy, Dr Augusta F Bronner, and Anna Mae Bowers Pp xx + 482 + xxiv (London and New York Alfred A Knopf, Ltd, 1930) 21s

It is difficult to imagine the audience for which this book is intended It purports to be the outcome of an attempt to show "psycho analysis as one of the scientific approaches to understanding of personality in a projected manual of methods of personality study", and the maze of material prompted the authors to compile "an organised statement of what had been contributed to date in psycho analysis" On the left-hand page are given what are considered to be the orthodox theories as presented by Freud, while on the right-hand page are the various modifications suggested by other writers The result, while being an admirable testimonial to the patience of the compilers, can scarcely be called useful For serious students the best approach is the original work of first-hand exponents, while for those who want to get a general idea of such work there are innumerable popular manuals, if it is to be considered as a reference book, then far more bibliographical references are needed Neither the structure nor the meaning of any subject can be adequately presented in this way

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Stellar Structure

IT has frequently been stated, by myself amongst others, that it is necessary to assume in the inside of stars a temperature of the order of mc^2/k in order to explain the generation of energy by the annihilation of matter, m being the mass destroyed in each process, c the velocity of light, and k Boltzmann's constant. This letter is written in order to make clear that this assumption is not necessary. It is perfectly true that the equilibrium constant of a process, subject to the laws of thermodynamics, is of the order $e^{-\epsilon/kT}$, ϵ the energy of the process in this case, of course, being equal to mc^2. The equilibrium constant does not, however, determine the generation of energy. What one is concerned with in the case of a star is the rate at which energy is produced; in other words, if one presupposes the simplest process of annihilation, the rate at which protons and electrons disappear in the form of radiation. This is analogous to the rate of chemical reaction, not to the equilibrium constant of a reversible reaction.

In most chemical processes the rate of reaction is governed by the number of molecules activated per second, which again depends upon the number of particles the energy of which exceeds a certain value, say, ϵ_1. This number is proportional to $e^{-\epsilon_1/kT}$, and one therefore finds, roughly speaking, that the rates of reaction are negligible unless the temperature is such that the mean energy of the molecule is comparable with the energy of excitation. Since this activation energy is usually of the same order as the energy of the reaction, the conclusion is often extended without great inaccuracy to the total energy of the process.

In the case under consideration, the annihilation of protons and electrons, it seems difficult to imagine any form of excitation, and the rate at which it proceeds can therefore scarcely depend upon a function of this type. Presumably, in such collisions as are effective, certain circumstances, which occur but rarely, have to be fulfilled. When these are fulfilled, and they may not be such as require any high velocities, matter is converted into radiation; in the vast majority of cases, a collision has no such result. If this view is correct, the rate of annihilation, and therefore the rate of generation of energy, will depend in the first instance on the number of collisions per second, which of course varies with the density and with something like the square root of the temperature, and in the second instance, upon the special circumstances which render a collision effective, and which may, or may not, depend upon the temperature. In either event the simple exponential expression is not applicable, and the conclusion that matter can only be annihilated and energy produced in stars where interiors are at temperatures of the order mc^2/k, that is, 1.1×10^{13} degrees, is valid.

It would be true if the matter radiation equilibrium has been attained and any further production required a change in the equilibrium constant. It is incorrect if the system has not reached equilibrium, for in this case thermodynamical reasoning is insufficient to determine the rate at which equilibrium will be approached.

F. A. LINDEMANN.

Clarendon Laboratory,
Oxford, Feb. 5.

REFERRING to Sir James Jeans's letter in NATURE of Jan. 17, p. 89, I may say that I fully acknowledged in my paper of November 1929 (*Mon. Not. Roy. Ast. Soc.*, **90**, p. 20) that Sir James was the first to recognise the principle that the mass M and luminosity L of a star are independent variables as regards steady state considerations. On p. 53 of that same paper (a page of which Jeans himself quotes in another connexion) I made a general reference of obligation to his work. In my last paper (*Mon. Not. Roy. Ast. Soc.*, **91**) I build on Jeans's permanent contributions to science in three places, mentioning him by name (pp. 4, 9, 51). I could not, however, adduce any of the specific results of his theory of stellar equilibrium in support of my conclusions, for they are totally different; and I could not contrast his results with mine without venturing to discuss his mathematics.

I cannot assent to Jeans's mathematics, because his theory of stellar equilibrium is in formal contradiction with his own (L, M) independence principle. It is an immediate consequence of this principle that for a given mass M in equilibrium the ratio λ of gas pressure to radiation pressure may have any value whatever between zero and infinity, depending on the arbitrarily assigned L. This is fundamental in my analysis. According to Jeans ("Astronomy and Cosmogony", pp. 88, 89) λ is small for large masses and large for small masses, and is calculable in terms of M (p. 97). Jeans may claim the principle, but his theory is not consistent with it.

The point of my analysis is the construction of configurations which satisfy the (L, M) independence principle, even for models for which $\kappa\eta$ is constant. The special properties attributed to these models by both Jeans and Eddington then disappear, and the new general properties which emerge (explaining as they do why some stars are very dense and others not) are shared by other models, since they depend only upon the occurrence of the central singularity $r=0$ in a certain system of differential equations. Jeans uses throughout Emden's solutions, which possess no singularities.

As regards the branching out of solutions near the boundary of a star, Jeans is considering a variety of models. *For any one model*, the solution is unique up to the boundary. The work of Mr. Fowler, Mr. Fairclough, and myself published in *Mon. Not. Roy. Ast. Soc.*, **91** (November 1930), discusses the family of such solutions arising from Emden's equation; with any definite configuration, of arbitrarily assigned mass, luminosity, and opacity, there is associated *one* member of the family of solutions, selected by a boundary condition which ensures that the boundary layers, of the prescribed opacity, enclose M and radiate L.

E. A. MILNE.

Wadham College, Oxford,
Feb. 5.

Generalisations and Modern Cosmogonies

PROF. R. A. MILLIKAN in his retiring presidential address of the American Association for the Advancement of Science (NATURE, Jan. 31, p. 167), refers to the assumption "that the radiation laws which seem to us to hold here cannot possibly have any exception anywhere" as "precisely the sort of sweeping generalisation that has led us physicists into error half a dozen times during the past century." This emboldens me to ask again whether there is any evidence whatever for the uniform propagation of radiation in all directions in space from a sun or a star. I asked it (NATURE, Nov. 29, 1913, p. 339) at the time of Millikan's "fifth significant discovery", when radioactivity was indicating the necessity of extending

the cosmical time scale Since then all modern cosmogonists it seems to me have constructed systems designed primarily to account for the maintenance of solar and cosmical energy on the scale demanded by this natural but perhaps unwarranted assumption

Although I have no desire to trespass in the controversies concerning the nature of cosmical radiation I may say that Millikan s views have always had a singular attraction to me because of the very difficulties to which he refers of finding a satisfactory kinetic picture of the instantaneous conversion of say 56 separate hydrogen atoms into one iron atom This to a chemist a reaction of the 56th order seems bizarre for has not Sir Joseph Larmor educated us to regard a reaction even of the third order as difficult to form any kinetic picture of ? But I like to think of these 56 atoms (or shall we say 55 ?) holding a committee meeting in the spacious regions of zero temperature and concentration with infinite time ahead of them and nothing to disturb them arriving at a decision (or possibly only awaiting a chairman) to rush into one another s arms and flash to us the birth of an iron atom

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Change of Density of Ethyl Ether with Temperature

IN connexion with my former studies on ethyl ether made in the Physical Laboratory of the Technical Institute at Warsaw I have made a study of the dependence of the density of ethyl ether upon temperature in the interval between 120° C and + 35° C using the method described by H Kamerlingh Onnes and J D A Boks (*Comm Leyden* No 170 b)

The dilatometer and the control tube were made of fused quartz carefully calibrated and provided each with a closely fitting quartz stopper The dilatometer was placed in a deep glass Dewar vessel so as to permit the observation of the level of liquid in the dilatometer The temperature was determined by two platinum resistance thermometers placed at different depths

There was great difficulty in selecting the cooling liquid The specially purified petrol ether which is commonly used for this purpose permits of lowering the temperature to 150° C but even at 70° C it

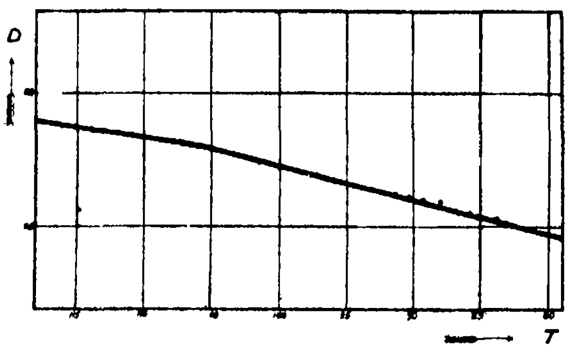

FIG 1

becomes so markedly disturbed as to make the observation of the levels of the liquid both in the dilatometer and the control tube quite impossible After several attempts I found that a mixture of chemically pure ethyl ether and ethyl alcohol remains clear down to 120° C Probably this is due to the fact that ethyl alcohol absorbs the last traces of moisture in the cooling liquid which would otherwise cause it to become disturbed at low temperatures

The density of ethyl ether as a function of temperature in the neighbourhood of the point 105 4° C is represented on the accompanying graph (Fig 1) The shape of the curve shows that the density of very carefully purified ethyl ether increases with the lowering of temperature from the value 0 6964 at 35° up to 0 8595 at 105 4° C With further lowering of temperature the density of ethyl ether still increases but the rate of increase is markedly lower According to former studies made in this laboratory there appears also at this temperature a change of the value of the dielectric constant and of the specific heat of ethyl ether (J Mazur NATURE 126 649 1930 M Wolfke and J Mazur NATURE 126 684 1930) Thus at the previously found transition point 105 4° C the density curve shows also a distinct change of character At 117 2° C (freezing point) the density has the value 0 8654

J MAZUR

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Jan 6

Crystal Structure of Martensite

IT was first shown by W L Fink and E D Campbell (*Trans Am Soc Steel Treat* **9**, 717 1926) and independently by N Seljakow J Kurdumoff and N Goodtzow (NATURE **119** 494 1927) that quenched carbon steels contain a phase with a tetragonal crystal structure which might be considered as a deformation of the body centred cubic structure of α iron This has been confirmed by other investigators and our present knowledge of the tetragonal martensite may be briefly summarised as follows The axial ratio increases from about 1 03 at 0 8

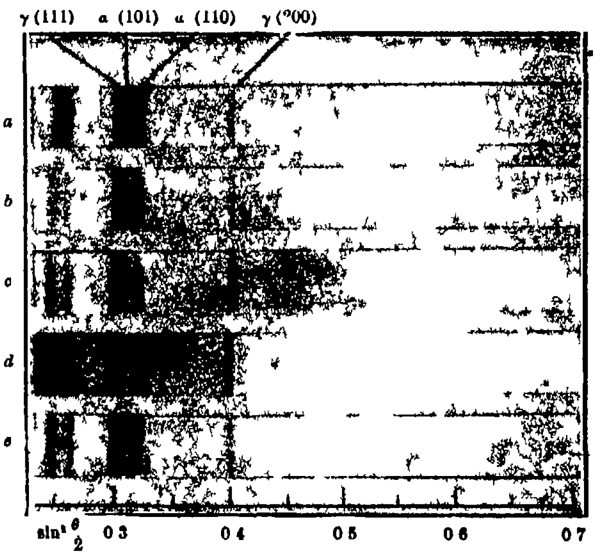

FIG 1 X ray photograms of quenched carbon steels The two lines γ ( ) and α (0) are separated in the original films a 0 80 per cent carbon b 1 04 per cent carbon c 20 per cent carbon d 1 35 per cent carbon e 1 35 per cent carbon after forty eight hours in liquid air

per cent carbon to 1 06 at 1 4 per cent carbon At lower contents of carbon the interference doublets corresponding to the tetragonal lattice are not resolved but in photograms of very rapidly cooled specimens the α Fe lines are slightly displaced in such a way as to indicate a tetragonal deformation The higher the carbon content and the higher the axial ratio the larger is also the volume of the unit cell

It is thus evident that there is a correlation between carbon content and lattice dimensions and it must be considered as an established fact that the tetragonal martensite has a homogeneity range of considerable

extent. Recent investigations by means of thermal (Ed. Maurer and G Riedrich, *Archiv f d. Eisenhütten wesen*, **4**, 95, 1930) and microscopic (F Wever and N Engel, *Mitt a d Kaiser-Wilhelm Inst f Eisenforschung*, **12**, 93, 1930) analysis have shown that the austenite martensite change takes place also in steels with a very low content of carbon This is in favour of the assumption that the tetragonal martensite is a supersaturated solution of carbon in α iron An X-ray investigation by G Kurdumoff and E Kaminsky (NATURE, **122**, 475, 1928) points very strongly in the same direction They find the dimensions of the axes c and a of the tetragonal phase to be linear functions of the carbon content, and the lines to intersect at a point corresponding to the elementary cube edge of pure α-iron On the other hand, Wever and Engel refrain from stating the axial dimensions obtained in their X-ray work, and emphasise the difficulties of exact determination, due to the diffuse interference lines and to the fact that the strongest lines of the tetragonal phase are covered by either γ- or α-iron lines

By using focusing cameras constructed by G Phragmén, which give a much higher dispersion than the ordinary Debye cameras, and by employing chromium *K*-radiation, which has a comparatively long wave-length, I was able to obtain photograms of quenched steel specimens of which the line (101) of the tetragonal phase is separated from the γ-Fe line (111) It was thus possible to determine the lattice dimensions of the tetragonal structure from the strong and comparatively sharp lines (101) and (110) Some of the photograms are reproduced in Fig 1 The results obtained are given in the following table

Per cent Carbon	Tetragonal Phase				γ Iron	
	a	c	c a	Volume per lattice point	a	Volume per lattice point
0 71	2 853 A	2 941 A	1 031	11 97 A³	3 581 A	11 48 A³
0 80	2 852	2 956	1 036	12 06	3 584	11 51
1 04	2 848	2 979	1 046	12 08	3 592	11 59
1 20	2 846	2 999	1 054	12 15	3 600	11 66
1 35	2 843	3 014	1 060	12 18	3 609	11 76
1 40	2 840	3 034	1 068	12 23	3 616	11 82

The results are reproduced graphically in Figs 2 and 3 The correlation of the points belonging to the tetragonal phase is very satisfactory The two curves of Fig 2, giving the axial dimensions as function of the carbon content, converge to a point corresponding to the edge of the elementary cube of pure α-iron, in complete agreement with the result of Kurdumoff and Kaminsky The present investigation has thus completely confirmed the assumption that the tetragonal martensite is a supersaturated solution of carbon in α-iron Ferrite and tetragonal martensite are thus one and the same phase, but as they are often present in one and the same specimen as separate micrographic structure elements, it seems convenient to denote the tetragonal phase as α′

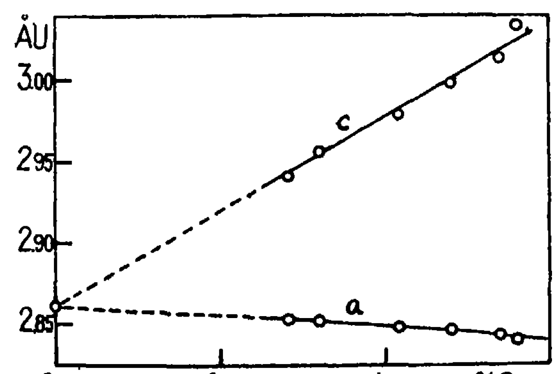

FIG 2.—Lattice dimensions of the α phase as function of the carbon content.

As shown by A Westgren and G Phragmén (*Jour Iron and Steel Inst*, **109**, 159, 1924), the carbon atoms, when dissolved in γ iron, do not occupy any points of the face centred lattice, but are statistically distributed in the interstices between the iron atoms Seljakow, Kurdumoff, and Goodtzow (*Zeit f Physik*, **45**, 384, 1927) suggested that the same might be the case in the α′ phase, and even proposed definite positions for the carbon atoms which would explain the tetragonal deformation, namely, at the centre of those faces which are perpendicular to the tetragonal axis This atomic arrangement is, however, very improbable, as the space available for the carbon atoms would be extremely small But even if a carbon atom were situated in one of those points, where the distances to the surrounding iron atoms are the greatest (½ 0 ½), the space available for the carbon atoms would be considerably smaller than in the face centred structure One would therefore expect the volume of the body centred lattice to increase much more rapidly with the carbon content than that of the face centred, while, as seen from Fig 3, the opposite is in fact the case On the other hand, a simple substitution of carbon atoms for iron atoms in the lattice would cause a decrease in the lattice dimensions, as the carbon atoms are much smaller than the iron atoms

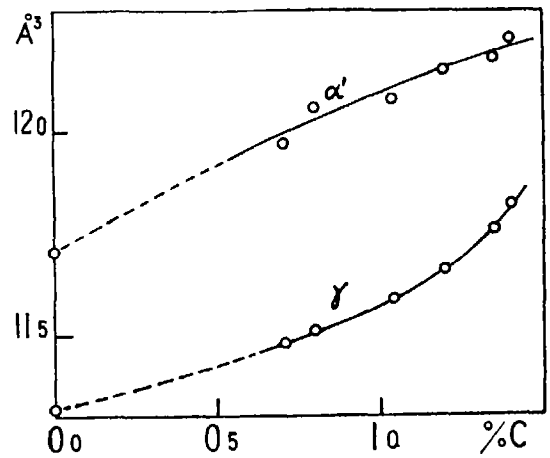

FIG 3 —Volume per lattice point for the α and the γ-phases as function of the carbon content

I am indebted to Dr G Hägg for the suggestion of still another possibility, namely, a complex substitution in such a way that a group of two carbon atoms is substituted for one iron atom in the lattice Such groups of carbon atoms have, in fact, been found by M v Stackelberg (*Zeit phys Ch* (B), **9**, 437, 1930) in several carbides of the composition MC_2 and a similar arrangement of hydrogen atoms by Hägg (*Zeit phys Ch*, in press) in ZrH_2 These compounds all have a tetragonal structure, and in most cases the axial ratio is higher than one, which is contrary to what is generally the case in deformed cubic structures This is explained by the assumption that the C_2 group is in these cases orientated parallel to the tetragonal axis, an explanation which holds equally well for the tetragonal martensite.

An attempt was made to find the positions of the carbon atoms by means of density determinations The density of the a' phase when containing 1 35 per cent carbon was calculated on the following three assumptions

(1) Addition of carbon atoms	7 65
(2) Complex substitution of carbon atoms	7 42
(3) Simple substitution of carbon atoms	7 19

A steel specimen with this content of carbon was quenched and afterwards placed in liquid air for 48 hours in order to increase the percentage of the a'-phase The density was found to be 7 62 As shown by an X ray photogram (Fig 1, *e*), the specimen consisted of a'- and γ iron, and the intensities indicate that there was more tetragonal martensite present than austenite The density of austenite with this composition is found by calculation to be 7 94 Assumption (1) is immediately ruled out, as the densities of both components would be higher than that of the mixture Assumption (3) has been shown above to be very improbable and would give 57 per cent γ iron, 43 per cent a' iron, while the X ray intensities indicate that the a' phase predominates Assumption (2) gives 60 per cent a' iron, 40 per cent γ-iron, in good agreement with the X-ray intensities

The only suggested structure of tetragonal martensite which explains the observed density, the increase of volume with the carbon content, and the elongation of one of the crystallographic axes may be described as follows In the body centred lattice, groups of two carbon atoms, statistically distributed, replace some of the iron atoms The carbon atoms are most probably orientated in such a way that the axes of the C_2 groups are parallel to the tetragonal axis of the lattice

The decomposition of the a' phase on tempering, as well as the reactions occurring on ineffective quenching, have also been studied, and the results obtained will be published elsewhere, with a more detailed account of the results reported here

EINAR ÖHMAN

Institute of General and Inorganic Chemistry of the University,
Institute of Metallography,
Stockholm, Jan 5

A Laboratory Method of demonstrating the Formation of Fronts and Vortices when there is discontinuous Movement in a Fluid

ACCORDING to views now generally accepted, extratropical cyclones are formed along surfaces of kinematical discontinuity between air-masses having different temperatures and moisture-contents, and during their growth they possess an asymmetrical structure Recent studies [1] of tropical cyclones show that they also have often a similar origin and structure

It is well known that vortices can easily be formed in a fluid by producing a sufficiently sharp discontinuity of velocity—as by suddenly moving a half immersed spoon across the surface of water A common method of studying stream-lines in water is by strewing aluminium powder on its surface. With water, however, the movement is so rapid that it is often difficult to follow its details Melted spermaceti, in which aluminium powder is suspended, is a very convenient medium for the demonstration and study of fronts and vortices similar to those which occur on a much larger scale in Nature

If a shallow layer of spermaceti is heated in a flat enamel dish over a plate of copper or brass, then, as is well known, the liquid layer is divided up into a series of small polygonal cells with liquid rising at the centres of the cells and falling at their peripheries If, now, a cylindrical rod is moved across the liquid with its axis vertical, the formation of the Kármán double row of vortices can be distinctly seen By

(a) (b) (c) (d)

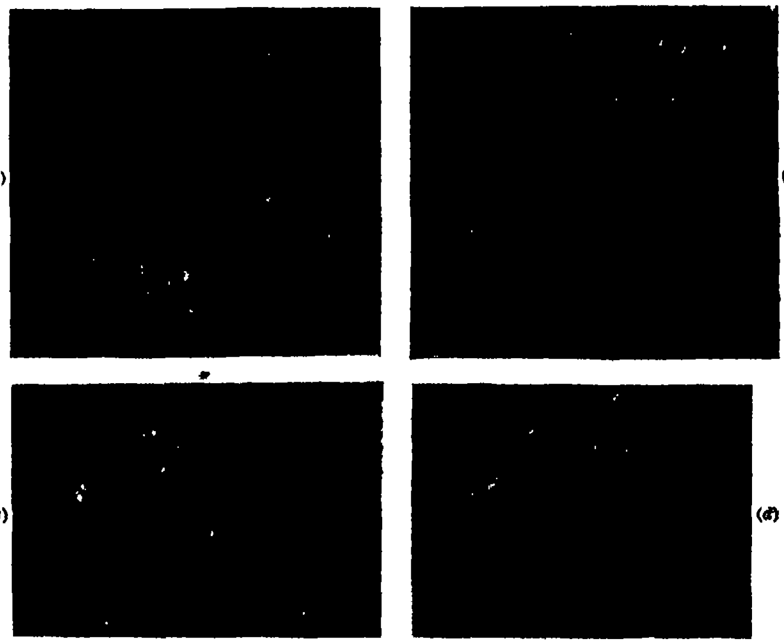

FIG 1

substituting a thin small angled wedge of wood with its narrow end dipping in the liquid, and moving it across the surface with its axis inclined, a wave motion is set up, and the stream which flows past the thicker end of the wedge rolls up into a succession of vortices which persist for some time before they disappear The development of these vortices resembles in many ways the development of a cyclone by the incursion of a tongue of warm air in cold air Fig 1 (*a*) and (*b*) shows photographs of such waves and vortices, the area of disturbance being obviously larger in the latter case When the liquid is at a low temperature, or when the speed of movement of the wedge is small, waves are set up without the formation of vortices, similar to those studied in the atmosphere by Bergeron and Swoboda (Fig 1 (*c*)) By giving a circular movement to the wedge, the series of cyclones along the polar front can be neatly imitated (Fig 1 (*d*))

The interesting question as to how far the instability of the liquid layer helps the formation and persistence of these vortices is being examined

K R RAMANATHAN
SOBHAG MAL

Meteorological Office, Poona,
Dec 23

[1] K R Ramanathan and A A Narayan Iyer "The Structure and Movement of a Storm in the Bay of Bengal during January 1929"

Modification of Quanta by Photo-Ionisation

IN the course of further experiments on the phenomenon described by Dr B B Ray (NATURE, May 17, p 746, and June 7, 1930, p 856), which was explained by Dr Ray and one of us (NATURE, Sept 13, 1930, p 398) as a case of partial absorption of the quantum leading to photo ionisation, we came across an interesting experimental result On using the copper $K\alpha_1, \alpha_2$ radiation and passing it through paraffin 1 mm thick, we obtained a modified line on the long wave length side, separated from the parent line by the approximate frequency distance $\Delta\nu = R$ (R = Rydberg constant) We are inclined to interpret it as a case of photo ionisation of hydrogen contained in paraffin in the combined state

In these experiments, a Uhler and Cooksey type of X ray spectrometer supplied by Messrs A Hilger, Ltd , was used The crystal of calcite was kept fixed The photographic plate was firmly clamped in the plate holder, which is itself a heavy metallic one and is firmly clamped to the body of the spectrograph, leaving no chance of the plate being displaced during an exposure The modified line was obtained on three plates only when a layer of paraffin was used as an absorber

The other alternative was to ascribe this line to partial absorption of the quantum by an electron in the aluminium (used as window) L_1 shell, but this explanation fails, as the energy of ionisation of aluminium in the L_1 shell is found to be equivalent to about 5 3 R, that is, about 72 volts, according to a recent paper by Söderman (*Phil Mag*, 616, Sept 1930)

In a previous letter (NATURE, Sept 13, 1930), it was pointed out that the phenomenon is analogous to the ejection of electrons from the K-shell of radioactive atoms by γ ray quanta coming from the nucleus, as found by L Meitner, Ellis, and others But there is one important difference The γ ray is supposed to impart the whole of its energy to the K-electron, which is therefore ejected with the energy $h(\nu - \nu_k)$ But in the present case, the X ray quantum is supposed to impart only a fraction $h\nu_k$ ($h\nu_k$ stands for energy of ionisation in the K shell) and then continues its journey with the energy $h(\nu - \nu_k)$ The two cases are therefore two extremes of the same phenomenon

It therefore seems probable that the quantum, whether internal (coming from the nucleus) or external (coming from an outside source as an X ray quantum), may on its passage through atomic shells impart any part of its energy to the electron from $h\nu_k$ to $h\nu$, and be therefore modified from ν to the frequency range $\nu - \nu_k$ to 0 We should expect that the modified beam will appear as a band with a sharp edge at $\nu - \nu_k$ and extending towards the longer wave length side indefinitely

We undertook to verify this deduction by sending the radiation through four layers of black paper (that in which photographic plates are wrapped), we have actually found evidence of this continuous band with a sharp edge at $\nu - \nu_k$ and extending towards the long wave length side indefinitely The copper $K\beta_1$ line was used in this case, and the crystal was kept fixed The range covered by the divergent beam of X rays was about 45′ (equivalent to 70 X U) The crystal was so placed that it could reflect all the wave-lengths between copper-$K\beta_1$ and copper $K\beta_1$ + 70 X U A single exposure of 50 hours' duration was given A feeble continuous radiation was indeed recorded in this region, and superposed on this was the modified line with a sharp edge on the short wave-length side and extending towards the long wave-length side as stated in the previous paragraph The separation between the edge of this line and the parent line was about 20 in ν/R units—20 4 being the C level in ν/R units as found by Söderman (*Zeit f Phy*, 52, 1929) A separate exposure was given for 10 minutes to record the copper $K\alpha_1, \alpha_2$ lines for reference and measurement No continuous radiation was recorded in the neighbourhood of copper $K\alpha_1, \alpha_2$, as the former is too feeble to be photographed in an exposure of 10 minutes

These experiments seem therefore to prove that the phenomenon is general, and the quantum can impart to the bound electron energy varying from $h\nu$ to $h\nu_k$, and be modified to any frequency less than $\nu - \nu_k$ Further experiments are proceeding

S BHARGAVA
J B MUKERJIE

Physical Laboratory,
University of Allahabad,
Nov 13

Simple Deposition of Reactive Metals on Noble Metals

ACCORDING to Nernst's theory of electrode potentials, a very small concentration of a reactive metal should be deposited on a noble metal when the ions of the former are brought in contact with the latter The effect is usually regarded as being too small for demonstration Dr G von Hevesy showed the effect by radioactive methods some years ago He deposited radioactive isotopes of lead and bismuth, presumably as metal, on such noble metals as platinum, gold, mercury, and copper, in some cases quantitatively, he showed, indeed, that the ions of any radio element could to some extent be deposited on noble metals when the latter were merely immersed in a solution The effect, I find, can be shown by some metals which are not radioactive I have obtained it with reactive metals like uranium, titanium, tungsten, and molybdenum on such noble metals as mercury, copper, and tin

It is obtained simply A liquid amalgam is shaken vigorously with a solution of a uranium, titanium, tungsten, or molybdenum compound in acid for a few minutes or less, removed from the solution, and well washed To the amalgam 0 1 gram of pure zinc is added, and the minimum concentration of sulphuric acid at which hydrogen is found to be evolved determined Whereas with an amalgam employed as a blank no hydrogen is visible with $2N$ sulphuric acid, the amalgams which have been shaken with uranium, titanium, tungsten, and molybdenum solutions are found to evolve hydrogen down to concentrations of 0 012, 0 0025, 0 002, and 0 002 N sulphuric acid respectively This catalytic effect cannot be due to the mere act of shaking, since it is not given when acidified solutions of manganese, chromium, and vanadium, which are metals similar to those given above, are shaken with amalgams to which zinc is afterwards added Nor can it be ascribed to oxides or other compounds of these metals, since these have never been shown to catalyse the formation of hydrogen when zinc is brought in contact with a dilute acid In the well known experiment of adding copper sulphate or platinic sulphate to zinc immersed in acid in order to catalyse the evolution of hydrogen, it is difficult to think that the catalyst is not metallic copper or platinum These catalysts, uranium, titanium, tungsten, and molybdenum, behave as though they were deposited platinum, and are therefore presumably in the metallic state

This view is supported by the fact that any of these metals when deposited by a current on a mercury cathode behaves catalytically towards the evolution of hydrogen exactly as does the amalgam which has been shaken with a solution Such amalgams appear entirely metallic Uranium and titanium have

hitherto not been deposited electrolytically from aqueous solutions on a cathode, but this has been effected by Mr R Groves in this laboratory

Mercury is the noblest metal on which we have succeeded in depositing these four metals by mere shaking Amalgams of copper, bismuth, lead, tin cadmium, and zinc show the effect in increasing amount, but only with molybdenum have we shown the presence of the catalytic metal by chemical means The amount deposited must in all cases be very small The electrode potentials of the four metals I have mentioned have never been accurately determined, but published work places uranium with manganese, titanium with zinc, and tungsten and molybdenum with cobalt and nickel in the list of electrode potentials of metals These similarities are supported by the behaviour of the metals towards acids, the difficulty of reduction of their ions in aqueous solution to the metallic state, and such evidence It is quite certain, in any case, that all four are more electro positive than tin, and therefore than lead, copper, and mercury

It is fortunate that each of the catalytic metals, as appears from measurements we are making, is quite insoluble in mercury The very small concentration deposited on the amalgam by shaking thus forms a separate phase with practically no loss through solution in the mercury It is this separate phase which is the catalyst for the hydrogen evolution which enables the small concentration to be detected

A S RUSSELL

Dr Lee's Laboratory, Christ Church,
Oxford, Jan 26

Development of Golgi Apparatus in Water- and Soil-grown Roots of *Vicia faba* Seedlings

WHILE *Vicia faba* is generally quoted as the type seed for successful germination in water under laboratory conditions, it is, nevertheless, noted that germination in sand is more rapid and much more reliable

The rate of growth of a seedling root under normal conditions depends on the activity of the meristem, and of the region of elongation This is directly related to the supply of available food material, which in turn is a function of metabolic rate, and consequently of respiration The respiration of a non hydrophyte, such as *Vicia faba*, might conceivably be adversely affected by growth in water Two series of seedlings were therefore grown, one in water and one in sand, to determine whether the difference in growth rate was linked up with any constant cytological variation

As has been already observed,[1] part of the food material visible in the cells of *Vicia faba* consists of Golgi apparatus, either in a reticular or granular form The examination of fifty seedlings, varying in length from one to sixteen centimetres, showed that such a Golgi apparatus is commonly present in dermatogen and periblem in both water- and soil grown roots It may be temporarily absent in the primary root during the early stage of development of the secondaries In the latter, as in the tertiary rootlets, it is also observed to occur The fixation method used is described in detail in the paper referred to above The sections were cut four to six microns thick

FLORA MURRAY SCOTT

University of California at Los Angeles,
California

[1] Scott, F M, "Occurrence of Golgi Apparatus in the Seedling of Vicia faba", *Amer Jour Bot*, 16, No 8, pp 598-605, October 1929

Swelling Pressure of Rubber

MEASUREMENTS of the swelling pressure of rubber (Stamberger and Blow, *Koll Zeitschr*, 53, 90, 1930) lead to the conclusion that the swelling pressure results from the attraction of solvent molecules by the molecules of gel A simple formula expressing the variation of molecular force of attraction with dilution, $P = K/V^2$, has been applied and gives satisfactory results In the present case P is the swelling pressure (MLT^{-2}), V is the volume of solvent bound to unit weight of jelly (L^3), K is a constant the meaning of which is obtained by substituting $P = K/V^2$ in the maximum work term $dA = PdV$

K is characteristic for all solvents and jellies, and expresses the potential energy when unit volume of solvent is bound to unit weight of the gel (The dimension of K is ML^5T^{-2})

The formula has been tested with all the data available and the constancy of PV^2 is fulfilled in a satisfactory manner

Full details will be published shortly

PAUL STAMBERGER

The Netherland Government Rubber Institute,
Poortlandlaan, Delft,
Jan 3

The Black-necked Grebe

I OWE thanks to the Writer of the Note on the black necked grebe for correcting my error in naming Linnæus instead of Latham as responsible for the generic title of the grebes (NATURE, Feb 7, p 201), but when he goes on to say that the "name is a label and need have no meaning in itself", I must ask how a label can be justified that conveys a false meaning, as *Podiceps* does Are misprints in scientific nomenclature to be reckoned indelible? That has not been the opinion of such ornithologists as Seebohm, A H Evans in the "Cambridge Natural History", and Prof Alfred Newton, who all write *Podicipes* In his "Dictionary of Birds", Newton notes about *Podicipedidæ*—"often, but erroneously, written *Podicipidæ* The word *Podiceps*, as commonly spelt, being a contracted form of the original *Podicipes* (*cf* Gloger, *Journal für Ornithologie*, 1854, p 430, note), a combination of *podex*, *podicis*, and *pes*, *pedis* its further compounds must be in accordance with its derivation"

HERBERT MAXWELL

Monreith

Embryology and Evolution

IN NATURE of Jan 10, Prof MacBride appears to deny that a cross between two types of *Cavia* to which I referred, and which leads to Mendelian segregation, was an interspecific cross Not only did Detlefsen,[1] who carried it out, regard it as such, but, also, the male hybrids were wholly sterile In view of the latter fact, I did not suppose that Prof MacBride would question its interspecific nature

In spite of Prof MacBride's disbelief in auto catalysis, I hope to demonstrate this phenomenon to students of the Natural Sciences Tripos next week, as I have done annually for some years

J. B. S HALDANE

University of Cambridge,
School of Biochemistry,
Sir William Dunn Institute,
Tennis Court Road, Cambridge,
Jan. 31

[1] Detlefsen, *Pub* 205, Carn. Inst Wash.

New Aspects of Radioactivity *

By Dr C D ELLIS, F R S

γ-RAYS AND NUCLEAR STRUCTURE

UNTIL a few years ago, the fundamental problems of physics were those concerned with the structure of the atom The nucleus was necessarily often referred to, but only in relation to its effect on the behaviour of the electrons in the atom It was found that for most purposes the net charge, Ze, was a sufficient description of the nucleus Within, however, the last three years, the whole attitude of physicists to this problem has changed , on one hand, our knowledge of those phenomena which depend on the intimate structure of the nucleus has been greatly increased , on the other hand, wave mechanics has proved to be eminently suitable for a theoretical attack on this problem, and has already provided a solution of some of the outstanding problems

Of the many lines of investigation which have been developed, not the least interesting is that of the characteristic electromagnetic radiation that can be emitted by radioactive nuclei These radiations are termed the γ-rays and are in general of considerably shorter wave-length than the X rays They bear the same relation to the structure of the nucleus as do the ordinary optical and X-ray spectra to the structure of the electronic system of the atom, but there is this one point of difference The optical and X ray spectra can conveniently be studied for a series of elements because the process of excitation is under control, but it is only in a few isolated cases that it has yet been possible to excite a nucleus by external agencies to emit characteristic radiation Some of the radioactive bodies, however, emit these radiations spontaneously, since the process of disintegration leaves the newly formed nucleus in an excited state and able to emit its characteristic radiation The nuclear spectra have therefore only been examined in detail for those radioactive bodies which happen to emit them, and it has been impossible as yet to find any general laws governing the arrangement of these spectra by noting the similarities in the spectra from a succession of different nuclei

The result of this was that, until a few years ago, while there was a great deal of information about the nuclear spectra of several radioactive bodies, it was still impossible to associate this with any definite feature of the structure Recently the position has changed greatly, and it now seems possible to view in the nuclear level systems which can be deduced from the γ-ray measurements the characteristic stationary states of α-particles or protons in the nucleus, and to associate such level systems directly with the ground states deducible from other evidence

METHODS OF INVESTIGATING THE γ-RAYS

A simple method that was of great importance in the early days of radioactivity was to investigate the absorption of the radiation emitted by a particular body by placing a radioactive source at some distance from an electroscope and observing how the ionisation decreased when successive sheets of some material such as aluminium or lead were interposed It was frequently possible to analyse the resulting absorption curve into a series of simple exponential curves, and thus to obtain a general idea of the different components of the complex radiation Methods such as this could never yield very precise information, and they have now been superseded by more accurate methods

The crystal method, in the forms used for X rays, has been applied with considerable success to γ rays [1] In one respect the technique is simpler, since in place of the X ray tube with all the apparatus necessary to run it, it is only necessary to use a fine tube containing the radioactive material, but in other respects the experiments are far more difficult Owing to the very short wave length, of the order of 40 X U to 4 X U , the glancing angles are extremely small, and not only is the adjustment of the apparatus considerably more difficult but it is also impossible to measure the wave length with much accuracy Further, in comparison with an X ray tube, the normal amount of radioactive material constitutes an extremely weak source of radiation As a result it has not yet been possible to push this method when using photographic registration beyond 16 X U Recently Steadman [2] has devised an arrangement, using an electrical counter in place of a photographic plate, which may overcome some of these difficulties

The method which has given us most of our information is based on the photoelectric effect The general principle is very simple and is as follows [3] A tube containing the radioactive body, the γ-rays of which are under investigation, is placed inside a small tube of some material of high atomic weight, such as platinum In their passage through the platinum, the γ-rays eject groups of photoelectrons the energies of which are connected with the frequency of the γ rays by the Einstein law Thus the γ ray of frequency ν will lead to the ejection of a series of groups of electrons of energies $h\nu\ K_{Pt}$, $h\nu\text{-}L_{Pt}$, etc , according to whether the conversion occurs in the K, L, etc , state of the platinum atoms This electronic emission can be separated out into a corpuscular spectrum by the usual method of semicircular magnetic focusing It is usual to register these spectra photographically, and there is not a great deal of difficulty in analysing them and deducing the corresponding γ-rays, since in most cases it is only the electronic group from the K level which is sufficiently intense to give a detectable effect The general application of the method is greatly limited by the fact that the photographic impression of the groups of electrons always shows as a broad, rather diffuse band The reason is that, although the photoelectrons are ejected from the platinum atoms with sharply defined energies, only those from the surface

* Substance of two lectures delivered at the Royal Institution on Nov 4 and 11

of the tube actually emerge with their full velocity. Those from the lower layers are retarded in their passage out, and cause the diffuse character of the band.

Fortunately, the radioactive atoms themselves provide us with much more favourable opportunities for observing this photoelectric conversion, by what is termed internal conversion. This is by itself an extremely interesting phenomenon, and will be referred to in detail later. For the present purpose it is convenient to describe it as follows. When a radioactive nucleus emits a quantum $h\nu$ of radiation, this does not always escape as such from the atom but may be absorbed by the electronic structure of the atom in its passage out. This internal conversion follows the usual photoelectric laws, and thus a radioactive body which emits γ-rays will also emit a corpuscular spectrum similar in every respect to that coming from the platinum tube already mentioned, except that the energies are now $h\nu - K_{rad}$, $h\nu\ L_{rad}$, The result is in principle in no way different from the previous case where the γ-rays were converted in the platinum, but the importance of this phenomenon for determining the wave length of the γ rays depends on the following facts. If a normal amount of radioactive material is deposited on the surface of a fine wire, the actual number of atoms is so small that the layer is in general less than one atom deep. The electrons liberated by this internal photoelectric effect therefore all escape with their full energy and give extremely sharp lines on a photographic plate, in striking contrast to the broad bands obtained by the normal external photoelectric effect. There is the further advantage that the probability of this internal conversion is so great that measurable lines can be obtained with far shorter exposures than by the other method, and the effects of γ-rays are detectable which are so weak as to be quite unattackable by the other method.

The γ-rays of many radioactive bodies have been analysed by this method, and the main features of the characteristic nuclear spectra are known. The accuracy with which the frequencies can be determined is, however, considerably lower than that realised with X-ray spectra. Even in the case of the bodies radium B and radium C, which have been extensively investigated, the relative frequencies are probably not known to much better than one part in five hundred, and the absolute error may be greater. The chief cause for this lies in the difficulty of obtaining a homogeneous magnetic field over a large area.

INTENSITIES OF THE γ-RAYS

An important method[4] of investigating the intensities has been developed by Skobeltzyn, based on the Compton effect of the γ-rays. A narrow pencil of γ-rays is allowed to pass through an expansion chamber and the recoil electrons liberated by the Compton effect of the γ-rays are observed in the usual manner. In addition, a magnetic field parallel to the axis of the chamber is applied at the moment of expansion, so that the tracks of the recoil electrons are curved by an amount depending on their velocity. By observing both the curvature and the direction of emission of the recoil electrons, it is possible to associate each electron with a γ ray of definite frequency. A statistical study is made of the relative number of the recoil electron tracks, and from a knowledge of the general laws of scattering it is possible to deduce the relative intensities of the γ-rays.

Owing to a variety of experimental causes, the resolution of the method is not very high, and the effect of two neighbouring γ-rays cannot always be clearly separated. This disadvantage, however, is far outweighed by the definiteness of the results about the intensity distribution throughout the spectrum, and by the fact that the method detects weak γ rays equally efficiently as strong γ-rays. The interpretation involves a knowledge of the laws of scattering, but there is both a reasonable theoretical foundation and internal evidence from these experiments which combine to render the uncertainties due to this cause of little importance at present.

The photoelectric method has been applied to determine the intensities of the γ rays by Ellis and Aston[5]. The corpuscular spectra liberated from the radioactive atoms themselves by the internal conversion are clearly of no use in this connexion, since the relative intensities of the groups depend upon the unknown laws of internal conversion. If, however, the corpuscular spectrum ejected from platinum is observed, we are concerned only with the normal photoelectric effect. Supposing that the X-ray absorption results could be extrapolated to the γ-ray region, it would then be possible to deduce the intensities of the γ-rays from the intensities of the corresponding electronic groups. It is, however, precisely this point which is doubtful, and the accuracy of this method is at present limited by the accuracy of the empirical formula which it was necessary to assume for the photoelectric method. The method, however, has one extremely important advantage, which is, that if a γ-ray is sufficiently intense to give a measurable corpuscular group, then the intensity of this group can be determined independently of neighbouring weak γ-rays. It will be seen that these two methods are really complementary, one supplying the deficiencies of the other. The γ-rays of radium B and radium C are the only ones that have yet been intensively investigated, but the results seem consistent, and we know not only the general distribution throughout the spectrum but also the individual intensities of all the strong γ-rays.

The results that have just been mentioned referred to the relative intensities of the γ-rays, and in the analogous case of X-rays or optical spectra this would be all that could be stated. However, in the case of the radioactive bodies it is possible to define and to deduce the absolute intensities. This depends upon the fact that the process of excitation is due to the disintegration of the atom. When a nucleus disintegrates, the departure of the disintegration particle, α or β, may leave the nucleus

in an excited state, and its subsequent return to its normal state is the cause of the emission of the γ-rays The γ-rays are, therefore, emitted only after this disintegration, and it is possible to define the absolute intensity of a γ-ray as the average number of quanta emitted per disintegration It follows that the absolute intensity of any γ-ray cannot be greater than unity The simplest way of deducing these absolute intensities is to make use of the measurements of the total amount of energy emitted in the form of γ-rays Knowing both the frequencies and the relative intensities of the γ rays, it is easy to calculate the average number of quanta of each frequency emitted per disintegration This further step has already been carried out for the γ-rays of radium B and radium C

If we now review the information that we possess about the γ-rays of radium B and C and anticipate that which we shall no doubt in time possess about the rays of other bodies, it will be seen that on the whole it compares very favourably with that available about X-ray spectra The accuracy of the wave-length determinations is certainly much lower, but we have this important information about the absolute intensities For example, a prominent γ ray of radium C has a wave-length of 20 2 X U, which may be in error by one part in five hundred to even one part in three hundred, but on the other hand, we can say that a quantum of this radiation is emitted by the nucleus on the average twice in every three disintegrations

APPLICATIONS TO THE STRUCTURE OF THE NUCLEUS

The preceding account will have shown the extent to which the spectroscopy of the γ-rays has advanced Its application to the problem of nuclear structure is only at the beginning, but it is already possible to indicate the possible lines of advance

It has been realised for some time that there were many examples of combination differences between the frequencies of the γ-rays from any one body, and that this indicated, what was otherwise probable, that the γ rays could be associated with a nuclear level system Little progress, however, was made with this idea for several years, due to the realisation of the difficulty of associating such a level system with any specific part of the nucleus In the nucleus there are α particles, protons, and electrons, and in general any of these particles might be the emitters of the γ-rays This question is still open, but there is now sufficient evidence to make it reasonable to try the hypothesis that the γ-rays are emitted by transitions of α-particles between stationary states in the nucleus

The theories of Gamow and of Gurney and Condon[6] have shown that we may regard the process of emissions of an α-particle as due to the gradual leak of the wave function through a potential barrier An extremely important result of this view is that the energy of the α-particle outside the atom, which can of course be measured, is the same as the energy of the α-particle in the stationary state in the nucleus which it occupied before the disintegration For example, the α-particle from radium C is found to be emitted with an energy of 7 68 million volts We therefore deduce that in the radium C nucleus there is an α particle level with a positive energy of this amount Such a level gives a natural basis on which to build the level system deducible from the γ-rays We imagine that as a result of some internal nuclear arrangement an α particle is excited to one of certain higher states, and that from these states it arrives at the ground state by emitting γ rays of frequencies corresponding to the energy differences It now follows, however, that if an α-particle can leak out through the potential barrier from the ground level, it can do so still more easily from the excited levels We should therefore expect to find a certain number of high speed α-particles corresponding to these modes of disintegration

The existence of such long range α particles has of course been known for a long time, and in fact many tentative suggestions have been put forward associating the energy differences of the groups of α particles with the frequencies of the γ rays The present day point of view, however, goes much further than this, since it predicts definite relations between the intensities of the γ rays and the number of long range particles That such a relation must exist can be easily seen in the following way Suppose that on the average out of every thousand disintegrations there are n cases where an α particle is excited to a certain state, the rate of leak through the potential barrier is given to a fair approximation by theory, and the probability of the nuclear transition can at least be estimated We are therefore able in terms involving only the unknown quantity n to write down the number of long range α-particles we should expect and the number of quanta of radiation Both these quantities can also be measured, perhaps not with a very high accuracy, but yet sufficient to see whether there is an agreement with theory or not

This is really a stringent test for the theory, because although the theories of the probabilities of nuclear transitions are necessarily tentative, any adjustment which proved necessary for one γ-ray must also apply to all the others By arguments of this type Fowler[7] has been led to associate one excited α-particle level of the radium C nucleus with the corresponding nuclear transition formed from the β ray spectrum It seems likely that this line of investigation will lead to definite and valuable results It is of course quite probable that several nuclear transitions will not be able to be associated with long-range α particles, but it would then be possible to draw the important conclusion that these transitions were due to protons or α particles of small positive or of negative energy

INTERNAL CONVERSION

Reference was made above to internal conversion and it was pointed out that groups of electrons are ejected from the K, L, M states of radioactive atoms with just those energies that they would have if radiation were emitted from the nucleus but was absorbed photoelectrically before it escaped

It has been frequently pointed out that there was no need and, in fact, no justification to assume that in this case the radiation was ever actually emitted at all[8] All that could be truly inferred from the experimental results was that an excited nucleus could either emit its excess energy as radiation or had some means of transferring this energy to the electronic structure of the atom

On the old quantum mechanics, it was difficult to imagine any method other than that of radiation transfer, but the wave mechanics suggests that there is a far more intimate connexion between the nuclear particles and the electronic structure The wave functions of the particles in the nucleus will extend out to a certain extent into the electronic region of the atom, and conversely the electronic wave functions will exist throughout the nucleus As a model, we may think that every electron in the atom occasionally passes right through the nucleus, and that a nuclear particle might sometimes for a very short time be found to be actually outside the nucleus

We have thus no difficulty in seeing, in a general way, how the nuclear energy might be transferred to the electronic system by a direct collision process Which process, radiation or collision, is predominant can only be settled by experiment, and the answer given by experiment in this case is fortunately unambiguous The measurements of Ellis and Aston[5] of the extent of this internal conversion and of the way in which it depends on the frequency of the associated radiation show clearly that the behaviour is incompatible with the radiation hypothesis, and we are thus led to conclude that the collision process is the most important It will be seen that this process is really a collision of the second kind, between an electron and an excited nucleus

The peculiar interest of this phenomenon lies in the fact that it represents an easily measurable example of direct interaction between the nucleus and the electronic system There are several other cases where the interaction between the nucleus and the electronic system must be taken into account, but only in order to give the finer details The importance of the phenomenon of internal conversion is that the entire phenomenon, even to its first approximation, depends upon interaction, and that no approach can be made to it with a simple point nucleus

However, quite apart from the intrinsic interest of this interaction, the phenomenon of internal conversion seems likely to provide valuable information about the stationary states in the nucleus The quantity that can actually be measured, the internal conversion coefficient, is the ratio of the probabilities of occurrence of this collision of the second kind and of the nuclear radiation transition The latter is determined mainly by the energy difference of the initial and final states, whilst the absolute energies are involved in the former In a general way it can be seen that the internal conversion should lead to a classification of the levels responsible for the γ-rays, or, in other words, should enable the γ rays to be associated with a definite part of the nucleus

While but little has yet been accomplished along these various lines of investigation of the nuclear levels, it is certainly true that the most difficult step has already been made The problem can now be clearly envisaged, and definite lines of work proposed which seem likely to lead to results The way appears open to an experimental investigation of certain radioactive nuclei, and to an interpretation of the experimental results in terms of nuclear phenomena

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[2] Steadman, *Phys Rev*, **36**, 460, 1930

[3] Ellis, *Proc Roy Soc*, A, **101** 1, 1922 Thibaud, Thèse, Paris, 1925

[4] Skobeltzyn, *Zeit f Physik*, **43** 354 1927 **58**, 595, 1929

[5] Ellis and Aston *Proc Roy Soc* A, **129** 180, 1930

[6] Gamow, *Zeit f Physik*, **51**, 204, 1928 Gurney and Condon, NATURE, **122**, 439, 1928

[7] Fowler, *Proc Roy Soc*, A, **129**, 1, 1930

[8] Smekal, *Zeit f Physik*, **10**, 275, 1922 *Ann d Phys*, **81**, 399, 1926 Rosseland, *Zeit f Physik*, **14**, 173, 1923

An Institute for Experimental Research in Surgery

THANKS to the munificence of Mr George Buckston Browne the Council of the Royal College of Surgeons of England will be able to build, equip, and maintain an Institute for Experimental Research in Surgery, to be known by the donor's name For the building and maintenance of such an Institute, and for the endowment of experimental research, Mr Buckston Browne has given £50,000, with a promise to make further additions until a total of £100,000 is reached

This munificent gift will give England what she now lacks—an institute where surgeons can carry out experimental research bearing on their art The Institute is part of a scheme which was initiated by the Council of the College of Surgeons some years ago, when it equipped laboratories for surgical research in connexion with the Museum in Lincoln's Inn Fields The workers now engaged in these laboratories have found that their investigations are crippled by the lack of a biological station or farm in the country where experimental animals can be maintained and observed under the best conditions Mr Buckston Browne's generosity makes the completion of the Council's scheme now possible

It will be remembered that three years ago Mr Buckston Browne acquired Down House, Kent, from Prof C G Darwin, F R S, and after restoring and endowing it, presented it to the British Association to be preserved as a memorial to Darwin, and for such scientific purposes as the Council of the Association might determine It was Mr Buckston Browne's original intention to establish the Institute which is to bear his name on the grounds attached to Down House, but certain circumstances compelled an alteration of this plan The chief of these was that the land lying to the west of the Down property and flanking

Darwin's 'sand-walk' was to be opened up for building purposes To save the adjacent fields from being built over, Mr Buckston Browne stepped in and obtained the freehold of the property —13 acres in extent It is this land which is to be the site of the Institute It is possible that arrangements may be made whereby the new Institute and Down House may be linked so as to work together for the advancement of knowledge

Mr Buckston Browne has recalled the fact that John Hunter, the founder of the Museum of the Royal College of Surgeons, maintained a farm at Earl's Court for experimental purposes He hopes that his Institute will be to modern surgeons what Earl's Court farm was to John Hunter

Mr George Buckston Browne, the donor, was born in Manchester in 1850, the only son of a well-known medical man—Dr Henry Browne, physician to the Manchester Royal Infirmary and lecturer in medicine to the Manchester Medical School Dr Henry Browne represented the fourth generation of a medical dynasty where son had succeeded father, the founder of the family having been Dr Theophilus Browne, of Derby, who was townsman and contemporary of Dr Erasmus Darwin, grandfather of Charles Darwin Mr Buckston Browne continued the family tradition, representing the fifth medical generation In 1866, at the age of sixteen, he matriculated as a student of the University of London, entered University College, was awarded medals in anatomy, chemistry, and midwifery, and gained the gold medal for practical chemistry and the Liston gold medal in surgery He became a member of the Royal College of Surgeons in 1874, and gained in open competition the house surgeoncy to his hospital (University College Hospital), where he served under Sir John Erichsen He also taught anatomy under Prof George Viner Ellis No one ever trained himself more thoroughly for his profession He is justly proud of the fact that the fortune which he now gives for the endowment of research in surgery has been gained in the zealous pursuit of his chosen profession

Obituary

Sir Andrew Balfour, C B, K C M G

THE death of Sir Andrew Balfour on Jan 30 at the early age of fifty-seven years has deprived the world of one it can ill afford to lose His remarkable knowledge of tropical medicine and hygiene, the result of years of practical experience in the field, research in the laboratory, and intensive study of the literature of the subject, had fitted him more than any other to be a leader and adviser in any movement concerned with the health of our great empire Physically he was a powerfully built man of striking appearance, with open, clean shaven face, searching blue eyes, and determined jaw, and these attributes, combined with a remarkable personality embodying unbounded energy, enthusiastic devotion to duty, absolute honesty of purpose, and an irresistible appeal, brought him not only to the high position he held in his profession, but also at the same time into the hearts of everyone who knew him His solicitude for the welfare of all, both high and low, who worked with him, and the personal interest he took in the aspirations or difficulties, whether great or small, of anyone who came to consult him, endeared him to a host of friends and admirers From his early days he threw himself with fiery zeal into all he undertook to do or say

As first director of the Wellcome Tropical Research Laboratories in Khartoum and medical officer of health of that city, and later, sanitary adviser to the Sudan Government, Balfour placed the medical and health services of the Sudan on a sound scientific basis Later, he established the Wellcome Bureau of Scientific Research in London, and commenced a graphic museum of tropical medicine which has developed into the Wellcome Museum of Medical Science Finally, he directed the building and organisation of the London School of Hygiene and Tropical Medicine, a most difficult task, which brought him to the end of his career The Great War found him with the Medical Advisory Committee before and after which he made various tours of inspection in tropical lands

Outside the particular sphere of his life's work, Balfour was an omnivorous reader, but biography, travel, and adventure pleased him most He was a life member of the Stevenson Club in London and Edinburgh, and took an active part in its proceedings What appears to be only a few months ago, he gave one of his characteristic lectures, which in his modesty he entitled a " Gossip about Robert Louis Stevenson He even found time to write books himself—books of adventure in his early day, such as ' Cashiered, and other War Stories ", " By Stroke of Sword ", " The Golden Kingdom ", and later, books and articles on public health and preventive medicine Some of his articles, such as those collected in book form as " War Against Tropical Disease ', were of a semi popular nature and appealed to a wide public

Balfour was an inspiring lecturer He never failed to hold an audience by the charm of his language, the graphic pictures he would draw of what he had seen in his travels abroad, his earnest condemnation of what was bad and praise of what was good, and the sudden outbursts of wit and humour To prepare his lectures he took endless trouble, which was often not apparent to those who listened to the easy flow of speech, always tinged with an accent indicative of his Scottish descent, of which he was supremely proud In conversation, with his remarkable knowledge of many subjects, he had no equal, and, when in the mood, would recount his experiences or tell stories in a manner to fascinate his listeners for hours

No account of his life would be complete without a reference to his passion for Rugby football A former Scottish international, he remained

throughout an enthusiastic supporter of the game which gave him his most inspiring relaxation He championed the Scottish teams in all their contests, which he frequently attended, and at the time of his death was president of the Scottish Rugby Union He loved to ride a horse, a form of exercise too seldom available, while shooting and fishing found their place in his general keenness for sport when opportunity occurred His was a life crowded to the full He did not know how to spare himself, though at times he felt the burdens which his devotion to tropical medicine and hygiene and his good nature prevented him from refusing No wonder that a few days before his death he wrote to a friend "My own life has been such a rush"

Andrew Balfour, or simply Andrew as he was to many of his friends, was born in Edinburgh on Mar 21, 1873 His father was a practitioner who brought up his family strictly according to the old Scottish tradition, and sowed the seeds of character which remained ever rooted in his son That such upbringing was not unnecessary to curb the spirit of adventure in the young is well illustrated by the behaviour at family prayers, where one or other, during the father's pleadings, would, at the risk of severest chastisement, make a silent circuit of the room from chair to chair From George Watson's College, Andrew passed to the University of Edinburgh, where he graduated M B, C M, in 1894 For a short time he joined his father in medical practice, but, as he said himself, this was not his "line of country" Accordingly he went to Cambridge in the following year with the intention of devoting himself to public health He took his D P H in 1897, and in 1898 his M D with a gold medal at Edinburgh with a thesis on the pollution of water by toxic dye-stuffs Finally, in 1900 he obtained the B Sc in public health During the South African War, 1900 1901, he served as civil surgeon, gaining the medal with three clasps A severe attack of typhoid fever brought him back to England more firmly convinced than ever that public health was to be his life's work

The establishment by Mr Henry S Wellcome in 1902 of the Tropical Research Laboratories at Khartoum and Balfour's appointment as director gave him his first great opportunity Not content with developing the laboratories, which would have been sufficient for a less energetic man, he undertook also the work of medical officer of health, and in a few years converted Khartoum, a former death-trap, into a healthy city At the same time, from his laboratories at the Gordon College, he showed not only those around him but also the whole of Africa, and, indeed, the whole world, through his well-known reports, what organised research could do to improve the health of the tropics His sanitary rounds were made on horseback in the early morning, while the rest of the day was spent at research in the laboratories, and this routine continued in spite of the terrible heat and periodic sand storms which smothered all in dust As a correspondent, closely associated with him in his Sudan days, wrote "All this he accomplished in virtue of his combative, virile, truth loving, honest personality" Occasional trips up the Nile and its tributaries gave him opportunities for observation on the diseases of the native tribes and their domestic animals This convinced him of the utility of a floating laboratory which could take the facilities of modern research into the heart of the country, and again through the munificence of Mr Wellcome such a laboratory came into being It was ever Balfour's hope that similar floating laboratories would be established on other great tropical rivers of the world On one occasion his research laboratories were almost completely destroyed by fire, during which he displayed the greatest daring in saving his records from the flames

In research, Balfour devoted himself chiefly to the blood and its parasites, describing a number of new forms The greater part of his time during several years was spent in investigating spirochætosis of fowls, and he became a convinced adherent to the view that spirochætes have a granular stage in their life history He spent many hours studying these organisms by dark field illumination, and actually saw, or thought he saw granules thrown off 'like drops of water from a dog's tail" One of his best papers was on fallacies and puzzles in blood examination

In 1913, leaving behind many who had learned to respect and love him, Balfour came to London to establish the Wellcome Bureau of Scientific Research Here he exhibited the same qualities which brought him fame in the Sudan The laboratories soon became recognised as one of the centres of medical research in London and—with Balfour, with his world wide reputation, as their head—as a bureau of information where all and sundry were sure of a welcome and of obtaining the latest views and facts regarding diseases and health problems in the tropics In the year of the foundation of the Bureau he extended his experience by a tour of the northern States of South America and the West Indies

The outbreak of the Great War made him restless to be doing something for his country, and to prepare himself for any emergency he entered into training with the Old Boys' Corps In 1915 he was in France, and later in the same year, with the rank of Lieutenant-Colonel, a member of the Medical Advisory Committee in the Near East In 1916, as president, he went with the Committee to India and Mesopotamia During a few months' leave in England in 1917, which might well have been spent in rest, having realised from personal experience the want of a concise account of tropical diseases for medical officers, he undertook the task of writing for the War Office a small book entitled "Memoranda on Medical Diseases in Tropical and Sub-Tropical War Areas" He was able to see the book through a second and third edition, and its success is proved by the recent appearance of the fifth edition The value of this book to medical officers in the War, most of them untrained in tropical medicine, cannot be over-estimated.

In 1917 Balfour was appointed adviser to the

Inspecting Surgeon-General, East Africa In 1918 he arrived in Egypt to undertake the presidency of a Public Health Commission to reorganise the public health service of that country Later in the same year, at General Allenby's request, he visited Palestine to report on the anti-malaria measures adopted there

In 1919 Balfour was again established at the Wellcome Bureau of Scientific Research, picking up the threads of work which had been interrupted by his war service Though settled in London from 1919, he was not at rest for long, for in 1921, at the request of the Colonial Office, he visited Mauritius and in 1923 Bermuda to advise on the health conditions in those islands On his return he took up the directorship of the London School of Hygiene and Tropical Medicine, and threw himself with his accustomed energy into every detail of construction and organisation of this great enterprise For seven years, broken only by short visits to the Sudan, Warsaw, and the United States and all too short holidays, he laboured unceasingly to make his School justify by its teaching and research the generosity of the Rockefeller Foundation, which had made its building possible

Balfour was a member of numerous committees, and from 1925 until 1927 was president of the Royal Society of Tropical Medicine and Hygiene, delivering as his presidential address an inspiring lecture on "Some British and American Pioneers of Tropical Medicine and Hygiene", which well illustrated the amount of research involved in the preparation of one of his discourses Writing of this lecture, a reviewer remarked that "this does something more than impart instruction It admonishes us of one of the serious deficiencies of the ordinary medical curriculum , namely, neglect of the History of Medicine Without a good knowledge of this history of hard work and self sacrifice under difficulties, how shall the old spirit remain alive and the ancient traditions of our profession be handed on unbroken?" It would seem that Andrew Balfour himself had imbibed much of the spirit of these old warriors and had carried on successfully the ancient traditions

In the midst of his great activities, Balfour was in constant demand as a lecturer and writer, and he rarely refused a request His knowledge of his own subject was profound, the result of a system of annotating current literature which he commenced in his Sudan days and continued to the end, though frequently this involved working far into the night Exhausted and overworked, a nervous breakdown brought his labours to a close in 1929 Though he fought his indisposition with indomitable courage, the enforced inactivity became, as he said himself, a vicious circle which prevented his recovery

Balfour received the C M G in 1912, the C B in 1918, and, in recognition of the great work he had done for our overseas possessions, the K C M G in 1930 The University of Edinburgh conferred on him the honorary degrees of D Sc and LL D , the latter of which was also given him by the Johns Hopkins and Rochester Universities of the United States of America He was a fellow of the Royal College of Physicians of London and Edinburgh He married in 1902, and leaves a widow and two sons, the elder of whom is completing his medical studies C M W

WE regret to announce the following deaths

Prof J S Dunkerly, Beyer professor of zoology in the University of Manchester, known specially for his researches on the Protozoa, on Feb 11, aged forty nine years

The Hon Sir Charles Parsons, O M , K C B , F R S , whose name is associated particularly with the development of the steam turbine, on Feb 12, aged seventy seven years

Mr W G Robson, lecturer in natural philosophy in the University of St Andrews, on Feb 16

News and Views

THE British Industries Fair, 1931, was opened on Feb 16, the London Section at Olympia and at the White City, the Birmingham Section at Castle Bromwich This year, for the first time, the catalogues of the two sections are in the same form, each having a classified index in nine languages—English, French, Spanish, Portuguese, Italian, German, Dutch, Swedish, and Danish This feature is an innovation in the Birmingham volume Advance overseas editions of the catalogues were issued on New Year's Day, and were despatched to 10,000 business men and potential buyers in Europe, Africa, parts of Asia, North America, and the east coast of South America, in time for the copies to be received before the recipients departed for the Fair The buyer from abroad can thus look first at the classified index in his own language, from which he can obtain a list of firms exhibiting the particular goods in which he is interested If he desires further information about particular firms, the alphabetical list of exhibitors gives him a description of everything shown by them The Fair continues to show remarkable growth This year both the London and Birmingham Sections have more exhibitors and cover a greater area than in 1930 Moreover, the total area of the Fair is still further increased by the holding of the cotton textile section at the White City, London, for which a separate catalogue is issued The London catalogue, it may be noted, contains descriptions of the exhibits of about 1200 manufacturers and the Birmingham entries bring the total of exhibitors to more than 2000

SINCE it is a British Industries Fair, only British manufacturing firms are permitted to exhibit, and no exhibitor may exhibit articles other than those of his own manufacture The Fair, it may be remembered, is organised by the Department of Overseas Trade and has been held annually since 1915 with the object of attracting important oversea buyers and bringing them into touch with the British producer The Birmingham section was established in 1920 as the

British Industries Fair (Birmingham), and for its organisation the Birmingham Chamber of Commerce is entirely responsible, but the two sections constitute in effect an annual integrated demonstration that Great Britain is still in the forefront of the industrial and manufacturing countries of the world. At Birmingham, the exhibits are those of the heavy industries, chiefly hardware and machinery, including electrical equipment. There is also a gas industries section organised under the auspices of a national committee fully representative of the various organisations in the industry. The London exhibits at Olympia range over a wide and diversified field of the 'light' industries, including, for example, cutlery, jewelry, glassware and china, furniture, toys, leather, scientific instruments, chemicals, foodstuffs, and tobacco. The Empire Marketing Board has an exhibit of Imperial food products and raw materials, cotton textiles being shown separately at the White City. There is also a British artificial silk goods exhibition at the Royal Albert Hall, South Kensington. The stands alone at the four exhibitions occupy no less than 610,000 square feet of space. We hope to give a further account of the Fair, with particular regard to the scientific exhibits, at a later date.

The interest of the Rubber Industry Bill, which passed its second reading in the House of Commons on Jan. 30, is at least as much in the principle involved of a compulsory levy for research purposes as in its intrinsic importance to the rubber industry. The question can scarcely be dissociated from that of the position of other research associations. In its last report the Advisory Council for Industrial and Scientific Research alluded to the financial instability associated with the voluntary contribution system, and expressed the belief that the associations would benefit greatly if some equitable form of levy could be substituted. In the same report, the Advisory Council expressed its disappointment that the results achieved by the various research associations are not being applied and utilised by the industries to a greater extent. In spite of the technical nature of the investigations carried out, there is often a gap between the completion of the investigation and the application of its results in practice. The more progressive firms, organised on scientific lines, admittedly profit most through their ability to utilise a potentially valuable discovery. Every investigation, however, that has important industrial applications tends to raise the general efficiency of the industry. Under modern conditions 'trade secrets' are of minor importance, and an important advance speedily becomes part of the general knowledge and technique in which all units share. To this extent the small manufacturer may derive sufficient benefit to enable him to meet external competition to which he would otherwise succumb.

On the broad issue it is probably true that, in view of the fundamental scientific work which most of the research associations have had to carry out, it is early yet to judge of their utility. We may admit that co-operative research of this kind is under definite disadvantages as compared with that carried out by the large industrial units. That such research associations are doing most valuable work is, however, not disputed by those who are in a position to know, and not the least service they render is in encouraging habits of co-operation and of a scientific outlook in certain sections of industry which, compared with those of other countries, are notoriously backward. Whether a compulsory levy can expedite what is partly educational work has yet to be demonstrated. It should, in the case of the rubber industry at any rate, secure the Research Association from a recurrence of its financial crisis, occasioned by the gradual decrease both of the voluntary contributions and the grants from the Department of Scientific and Industrial Research. The proposed contribution of the manufacturers is limited to one twenty-fifth of one penny per pound of raw rubber purchased, and will provide an average sum of £15,000 per annum for five years. On last year's rubber consumption this would be provided by a contribution of not more than one forty-fifth of a penny.

On Feb. 28 occurs the centenary of the birth of the astronomer Edward James Stone, who, for ten years, was first assistant to Airy at Greenwich, and was afterwards successively Her Majesty's Astronomer at the Cape of Good Hope and Radcliffe Observer at Oxford. Stone also served as secretary of the Royal Astronomical Society, in 1868 was awarded its gold medal, and during 1882–84 served as president. During his ten years at the Cape, he observed the total solar eclipse of April 16, 1874, and the transit of Venus of Dec. 8, 1874, and eight years later was entrusted with the superintendence of the work of the Government expedition to observe the transit of 1882. He also reduced and published the observations made at the Cape by his predecessor, Maclear, and completed a systematic survey of the southern heavens from the south pole to 115° N.P.D. His final catalogue contained 12,441 stars, and it was for this work that he was awarded the Lalande Medal of the Paris Academy of Sciences. Stone died at the Radcliffe Observatory on May 9, 1897.

In the *Quarterly Review* for January is an article by J. M. Hone on "The Royal Dublin Society and its Bicentenary". A Dublin Philosophical Society, with aims similar to those of the Royal Society of London, was founded by William Molyneux, and Sir William Petty had been president, but it had ceased to exist owing to the Irish Civil War which followed the deposition of James II. From its ashes, however, may be said to have sprung the Dublin Society, of which, on its formation in 1731, the public-spirited Thomas Prior was the first secretary. Its interests, the promotion of agriculture, manufactures, arts, and sciences, quickly made the Society of importance. "It attracted to itself", said Lecky, "a considerable number of able and public-spirited members, and it was resolved that each member, on his admission, should select some particular branch, either of natural history, husbandry, gardening, or manufacture, should endeavour as far as possible to make himself a complete master of all that was known concerning it, and should

draw up a report on the subject" Granted a charter in 1750, the 'Royal' title was assumed in 1820 For many years the Society had as its house the Dublin mansion of the Duke of Leinster, but this was taken over in 1923 by the Free State and converted into Parliament buildings, and the activities of the Society are now all concentrated at the fine premises at Balls bridge With a variety of interests to serve "the main work of the Society has been, and is still the promotion of the agricultural interests of the country"

To choose a popular, though maybe difficult subject, to invite contributions thereon from well qualified experts, then to stage a discussion in the inspiring setting of an 'exposition', congress, or the like, is a truly American custom and one which, though by no means contrary to academic or technical policy in Great Britain, is perhaps not quite so frequently in evidence here as it might be The Institution of Petroleum Technologists sponsored such an event on Jan 13, and thereby added what has long been wanted to complete the already detailed American picture of salt technology in its relationship to petroleum—the Eurasian evidence Not that European scientific workers have been backward either in their study of salt bodies, in their presentation of theories of more universal application, or in their published views but to some extent the Gulf Coast occurrences have tended in the past to sway opinion (largely by the volume and detail of publication devoted to the subject, also influenced by the magnitude of modern geophysical explorations in that region), and it was time that the even balance should be restored

THAT we yet have much to learn of this fascinating subject, and that North Germany, Rumania, Persia, and even lesser known regions in the remoter parts of Asia have much to teach us, especially in connexion with salt oil association, is generally conceded, so that the papers presented in London were timely J Romanes discussed the salt domes of North Germany, Dr G M Lees dealt with some depositional and deformational problems of salt, F G Clapp contributed what we may perhaps term the 'liaison' paper on the Gulf Coast, without which no discussion of natural salt bodies would seem complete, J V Harrison described the salt domes of Persia, probably the classic region of visible saline achievements, Dr A Wade dealt with intrusive salt bodies in coastal Asia, South West Arabia, E de Golyer directed attention anew to the origin of Gulf Coast salt domes, L Owen brought forward some 'moot points' in current theories, Dr C Schmidt wrote on the salt dome area of Celle, Germany, while C Sundberg gave an account of recent geo-electrical methods

THE centenary of the death of Henry Maudslay, the eminent mechanician and engineer, which was noted in NATURE, Feb 14, p 245, was commemorated on Sunday, Feb 15, by a special service in St Mary's Church, Woolwich, in which Maudslay was married and in the churchyard of which he is buried The service was conducted by the Rector of Woolwich, Canon A M Pickering, and was attended by the Mayor of Woolwich, Councillor Miss G E Walters, members of the Borough Council and various societies, and by representatives of the Maudslay family During the service, Mr F Carnegie Superintendent of Woolwich Arsenal, in which Maudslay began work at twelve years of age, gave an address on the work and character of Maudslay, making especial reference to his improvements in the lathe and their great influence on the development of machine tools Though Maudslay's life was mainly spent in London, he always retained a great affection for his native borough, and it was therefore only fit that Woolwich should honour his memory After the service, the mayor, on behalf of the Newcomen Society, laid a wreath on Maudslay's tomb In works of reference the date of Maudslay's death is given as Feb 14, but the date on the monument is Feb 15 In view of the fact that the monument commemorates other members of the family and that it was erected soon after Maudslay's death, it may be taken that Feb 15 is the correct date

THE short wave broadcasting and wireless telephone and telegraph duplex station which has been supplied by Marconi's Wireless Telegraph Company to the Vatican City, and was formally inaugurated with a Latin speech by His Holiness the Pope on Feb 12, has a world wide range In its main features, the transmitter follows the design of the Marconi short wave high speed beam transmitters, which are used in the British Imperial beam stations, and it was manufactured at the Marconi Works at Chelmsford The complete installation consists of four main panels, designed for telephony and high speed telegraphy on either 19 84 or 50 36 metres On telephony the transmitter is rated to deliver from 8 to 10 kilowatts of unmodulated carrier wave energy to the aerial feeder system, the output depending slightly on the wave length used On continuous wave telegraphy the rating is from 13 to 15 kilowatts to the aerial feeder A special Marconi type of vertical short wave aerial is used for transmitting, there being a separate aerial for each wave length The transmitting room is situated in a part of the grounds in the Vatican which is surrounded by a Roman wall 45 ft high, while the masts, 200 feet in height, are placed outside this wall In order not to destroy the amenities of the Vatican gardens, a tunnel 141 feet long has been constructed under the Roman wall to accommodate the feeders connecting the transmitter with the aerial A special receiver secures good telephone and telegraph duplex communication between the Vatican City and any part of the world, telephony being possible from any telephone installation in the Vatican City This receiver is situated in one of the rooms of the transmitting station and utilises a vertical aerial placed at a distance of only a few yards from the sending aerial and suspended from the same triatic

IN *World Power* for February an interesting account is given of the South Scotland Electricity Scheme (1930) The area covered by the scheme is 4308 square miles and the population is nearly 256,000 The stations selected by the Central Electricity

Board for operation are a thermal station at Galashiels and five water power stations in Galloway Little of this district has been developed electrically, but much of it consists of forest and moorland It is hoped that by 1935 the water power stations will develop 102,000 kilowatts It is anticipated that much of this power will be absorbed in the Central Scotland and North West England areas The construction of the water power stations may be postponed, however, unless the iron and steel, coal, and shipbuilding industries in Central Scotland and the cotton industry in North West England improve The operation of the water power stations is primarily intended to help the supply at times of 'peak' load The commissioners have planned an extension of this system so as to connect it with the North East England Scheme at Newcastle It is very desirable that such a line should be constructed as soon as possible, owing to possible future requirements of the London and North Eastern Railway The northern district of Northumberland, which is without an electricity supply, could also be served Although this is desirable, it does not seem attractive at present from the financial point of view The capital charges of the water power stations are heavy It is estimated that the cost to the Board will vary from 0 38*d* per unit in 1934 to 0 34*d* per unit in 1943 The average price to the consumer will be less than 0 5*d* per unit

On Feb 11, Mr E L Gardiner gave a lecture to the Television Society on "The Stenode Radiostat and its Application to Television" This type of transmission has not yet been tried experimentally, but from a mathematical consideration of the problem it appears possible to generate a signal to which only the stenode will respond, and which, even when superimposed on ordinary transmissions, will cause no interference In its simplest form the stenode radiostat is a very sharply tuned receiver A wireless receiver with a very peaky resonance curve, however, gives a reproduction which is woolly, due to the attenuation of the higher frequencies consequent on the sharp tuning To correct this, the low frequency amplifier in the stenode is designed to emphasise the higher frequencies, so that the final output is fairly even throughout the audible range Sharp tuning in a straightforward circuit causes, among other difficulties, instability, and to overcome this the superheterodyne principle is used With this circuit selectivity can be made as keen as is necessary, simply by reducing the frequency of the intermediate amplifier, and this without altering the form of the resonance curve By using the superheterodyne circuit with six valves and comparatively simple tuning arrangements, a satisfactory separation of stations only two kilocycles apart can be secured For a similar result with a band-pass filter circuit at least six ganged circuits are necessary A better method of employing the stenode principle is to insert a quartz crystal, cut to resonate at the required frequency, in the circuit of the intermediate amplifier This, due to the fact that the crystal acts as a very high resistance to all frequencies but its resonant frequency, gives a much sharper tuning, and makes it possible to get almost any degree of selectivity.

In his Friday evening discourse delivered at the Royal Institution on Feb 13, Prof F L Hopwood discussed ultra sonics or inaudible sound Sound is, of course, produced whenever a vibrating body is placed in a material medium, whether the latter is a solid, a liquid, or a gas For sounds to be audible, the vibrations must not only be of sufficient amplitude, but also their frequencies must lie within the range 20-20,000 Disturbances of the same type as sound-waves but having frequencies exceeding 20,000 vibrations per second are termed ultra sonic Remarkable effects are obtained when sound waves of great intensity, and frequency of about half a million, are generated in an oil bath by means of a quartz crystal set into resonant vibration by a thermionic valve oscillator Acoustic radiation pressure exerted on the free surface of the oil may raise in it a mound several centimetres or even inches in height, and cause it to erupt droplets like a miniature fountain On plunging vessels of appropriate form into this mound of oil, vibrations of great intensity may be communicated to the walls of the vessels, or, through the walls, to liquids contained in them Following the methods of Langevin, Boyle, and Wood and Loomis, demonstrations were given of reflection, refraction, and interference of sound waves of short wave length, the production of bubbles and expulsion of dissolved gases from liquids, acoustic distillation, transverse vibrations in solids accompanied by anomalous movements of dust particles, flocculation of suspended matter and production of emulsions, acceleration of chemical action, pronounced thermal effects, remarkable effects produced on plants, bacteria, muscle nerve preparations and on living organisms such as planaria and fish

In view of the pessimistic opinions often expressed regarding some of our industries, the figures relating to steel production recently given by Mr W B Jones, at the first annual general meeting of Steel Industries of Great Britain, Ltd, are of considerable interest One aspect of the steel industry is reflected in the total amounts of steel produced in Great Britain, Western Europe, and the whole world respectively Taking the three years 1913, 1925, and 1929, the figures for Great Britain were 7,660,000, 7,390,000, and 9,640,000 tons, for Western Europe 25,670,000, 25,440,000, and 34,990,000 tons, and for the world 75,150,000, 88,930,000, and 118,300,000 tons After referring to the disadvantages steel makers suffer from, Mr Jones said, "it is surprising to find how well the British steel industry has stood up against these handicaps" "In 1929, a year in which Western Europe was able to take full advantage of the handicaps in its favour, production of British steel not only reached its highest figure, but the relation of its production to that of itself and Western Europe added together, which in 1913 was 23 per cent, in 1929 was only reduced to 21 6 per cent." Though not referred to by Mr Jones, it may be remarked that Great Britain has to import

a considerable proportion of the iron ore used, in 1928, 11,261,000 tons of ore were produced in the country and 4,439,000 tons imported

THE Pharmaceutical Society's second conversazione was held in the Society's house in Bloomsbury Square on Feb 10 The whole of the premises, including the School of Pharmacy, the library and museum, the pharmacological laboratories, and the research laboratories, were thrown open The council chamber contained an exhibition of portraits of pharmaceutical interest and old pharmaceutical apparatus and equipment Among the exhibits in the laboratories were the following diagrams showing the method of estimating the absorption of calcium through the intestine, growth charts of animals suffering from a deficiency of vitamins, methods of distinguishing between vitamins B_1 and B_2, a demonstration of recent work showing that carotene is changed to vitamin A in the animal body the latest forms of pharmaceutical apparatus under working conditions, army and navy pharmaceutical equipment, samples of crude drugs about to be added to the British Pharmacopœia and the British Pharmaceutical Codex, the use of the quartz lamp for detecting adulterants in drugs, the syntheses of various organic chemical drugs, including camphor, salvarsan, and anæsthesine

THE Council of the National Museum of Wales, in spite of the financial stringency of the times, continues to pursue a strong policy in regard to the erection of the museum buildings Bearing in mind that the Government grant of £50,000 promised in 1928 was conditional on the full building programme of approximately £150,000 being proceeded with, the Council has proceeded with the second portion of the scheme The estimated cost is £81,987 The sums in the hands of the Council are insufficient, but the councillors go forward believing that their countrymen will support them in their endeavours The past financial year brought excellent contributions, amounting in all to £26,767, and Cardiff City Council voted the munificent sum of £21,000, to be spread over a period of seven years A considerable sum still remains to be collected, and during the course of the present year every effort will be made to secure the balance We trust that the effort will be abundantly successful, the Welsh National Museum has set a new standard for museum construction in Great Britain, and the energy, foresight, and faith of the members of its council deserve every encouragement

THE scheme for the award of the "Beit Railway Trust Fellowships for the Two Rhodesias" has now been completed This scheme has been made possible by the provisions of the will of the late Sir Otto Beit and offers facilities for two years' post graduate work for three candidates The fellowships will be tenable at any university or institution, approved by the trustees, in South Africa, Great Britain, the Oversea Dominions, Europe, or the United States of America Each fellowship is valued at £250 per annum if held in South Africa and £375 per annum if held overseas Preference will be given to South Africa, if the suggested course permits The chairman of the advisory board for the administration of these fellowships is the Governor of Southern Rhodesia Applications for information of conditions, etc, with reference to the fellowships (one of which is that the applicant shall have resided in Northern or Southern Rhodesia for three full years prior to application) should be made to the Secretary, Advisory Board, Beit Railway Trust Fellowships for the Two Rhodesias, P O Box No 4, Bulawayo, Southern Rhodesia

THE after shocks of the New Zealand earthquake are becoming less frequent and less violent, though strong earthquakes on Feb 8, 12, and 13 brought down some already damaged houses at Napier A harbour official reports that although the bed of Napier harbour rose during the earthquake it has since subsided gradually It appears to be still about 7 feet above its former level, but coastal steamers will be able to use the harbour, though additional dredging will be necessary The latest reports show that 133 persons were killed at Napier, 71 at Hastings, and 36 elsewhere

MADAME CURIE has been awarded the Cameron Prize of the University of Edinburgh for 1931, in recognition of the important therapeutic advances that have been made in recent years as a result of her discovery of radium

THE Council of the Iron and Steel Institute has awarded the Bessemer Gold Medal this year to Sir Harold Carpenter, professor of metallurgy in the Royal School of Mines, Imperial College of Science and Technology, London The award is made in recognition of distinguished services rendered by Sir Harold Carpenter in the advancement of metallurgical science, and of the valuable research work performed by him in relation thereto

AT the annual general meeting of the Quekett Microscopical Club, held at 11 Chandos Street, Cavendish Square, W 1, on Feb 10, the following officers and new members of committee were elected *President* Mr J Ramsbottom, *Hon Treasurer* Mr C H Bestow, *Hon Secretary* Mr W S Warton, *Hon Reporter* Mr A Morley Jones, *Hon Librarian* Mr C H Caffyn, *Hon Asst Librarian* W P Sollas, *Hon Curator* Mr C J Sidwell, *Hon Asst Curator* Mr R G Evans, *Hon Editor* Mr W S Warton, *New Members of Committee* Mr R G Evans, Mr W J Lloyd, Mr J M Offord, Mr D J Scourfield

WITH reference to the review of his book on "Fourier's Series and Integrals" (Ed 3) which appeared in NATURE, Oct 25, 1930, Prof H S Carslaw has written pointing out that the reviewer wrongly gives him credit for noticing that a certain Wilbraham in 1848 anticipated Gibbs's discovery in 1899 of the property now generally known as "The Gibbs Phenomenon" Wilbraham's paper was cited by Burkhardt in his article on "Trigonometrische Reihen und Integrale" in the "Enc d math Wiss" (Bd 2,

Teil 1, 2 Hälfte, p 1049, 1914), and there is also a reference to the matter in the article by Hilb and Riesz in Bd 2, Teil 3, p 1203 (1924) Prof Carslaw's attention was directed to Wilbraham's paper by Prof G N Watson

A USEFUL statistical summary entitled the "Mineral Industry of the British Empire and Foreign Countries" has been compiled by the Imperial Institute (H M Stationery Office, 5s 6d) The volume includes statistics for 1927, 1928, and 1929, where available, for some fifty minerals Under each heading are given the total production for each producing country, and the imports and exports for all countries Minerals are arranged alphabetically Quantities are given in tons, hundredweights, or pounds The uniformity with which the statistics are given much facilitates use and comparison, and the volume should meet with wide acceptance An appendix gives lists of statistical publications for each State

A CATALOGUE (New Series, No 24) of some 1400 second hand works on natural history, classified under the headings of periodicals and publications of learned societies, zoology, botany, geology, mineralogy, mining, etc, astronomy, chemistry, etc, and Linnæana, has just been published by Messrs Wheldon and Wesley, Ltd, 2 Arthur Street, W C 2

APPLICATIONS are invited for the following appointments, on or before the dates mentioned — An assistant lecturer in the Department of Mathematics and Physics of the Polytechnic, Regent Street —The Director of Education, The Polytechnic, Regent Street, W 1 (Feb 27) A forestry inspector under the Department of Agriculture of the Irish Free State—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C 8 (Feb 27) A lecturer in pathology in the Department of Pathology and Bacteriology of the University of Leeds—The Registrar, The University, Leeds (Mar 2) A male senior lecturer in the Department of Education of King's College, London—The Secretary, King's College, Strand, W C 2 (Mar 6) A chief designer in the Design Office of the Department of Technical Education of the Egyptian Ministry of Education—The Under Secretary of State, Ministry of Education, Cairo, Egypt (Mar 9) A full-time teacher in the Department of Chemistry of the West Ham Municipal College—The Principal, West Ham Municipal College, Stratford, E 15 (Mar 14) A temporary hydrologist and a temporary biologist under the Ministry of Agriculture and Fisheries, for research work in connexion with the survey of new fishing grounds by H M S *Challenger*—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (June 1)

ERRATUM —NATURE, Feb 14, p 237, col 2, line 3, for "raise the temperature" read "lower the melting point"

Our Astronomical Column.

Bright Meteor Photographed —The *Journal* of the B A A for January contains a reproduction of an interesting photograph of a bright meteor, obtained on Sept 19, 1930, by E H Collinson at Ipswich The meteor was observed visually by Mr J P M Prentice at Stowmarket From a combination of the two, Mr A King has deduced the path of the meteor, the speed came out 24 m p s, which is 3 m p s less than the parabolic speed The luminous flight began at a height of 79 miles, and ended at one of 54 miles The photograph indicates three explosions, after each of them the track on the plate suddenly widened, and then gradually grew narrow again, the calculated heights at the explosions are 68½, 61, and 58 miles respectively The path produced ended in the sea, 16 miles south east of Brightlingsea The inclination of the path was 52°, and the perihelion distance 0 34 unit The motion was inward Most meteor photographs have been obtained accidentally on plates exposed for other purposes, but Mr Collinson uses a specially constructed automatic camera for the purpose of securing them, he is to be congratulated on this fine result

Pluto —M Mineur, assistant at the Paris Observatory, contributes an article on Pluto to *L'Astronomie* for December, in which he directs attention to the two remarkable relations between the orbits of Pluto and Neptune

(1) Their periods are almost exactly in the ratio 3 to 2 This relation may be rendered quite exact when the period of Pluto is known with great accuracy

(2) They have very nearly a common line of apsides, the perihelion of Pluto being in longitude 223° 14 6′, and the aphelion of Neptune 224° 1 1′, both for the equinox of 1930 0

If they were simultaneously on the apse-line, there would be a type of regular periodic motion, but this is not actually the case It is interesting to note that in the two other pairs of interlocking orbits with which we are acquainted, satellites VI and VII of Jupiter, and satellites VIII and IX of Jupiter, the apojoves of each pair are roughly opposite to each other It is difficult to think that the relationship can be permanent in the case of Neptune and Pluto, as the perturbations that they undergo from the other planets must be decidedly different

Nakamura's Comet —*Bulletin* No 183 of the Kwasan Observatory, Kyoto, gives some more particulars about this comet It was discovered photographically on Nov 13 on plates taken with the 11 cm triplet lens, and was then of magnitude 13 5 Mr Nakamura observed it visually on Nov 16, noting that it appeared fairly sharp and somewhat elongated The following photographic positions are given, presumably for the equinox of 1930·0

			R.A	N Decl.
1930 Nov	13	57635 U T	$3^h 40^m 41 44^s$	18° 53′ 25 4″
	14	51980	3 37 52 69	18 41 1 0
	15	56116	3 34 51 86	18 28 12 5

The parabolic elements deduced from these by Mr Y Sibata were telegraphed to Europe, and have already been published in NATURE

The seconds of R.A on Nov 13 were printed as 14 in the circular, but it is fairly evident, both by comparison with the telegraphed position and by differencing from the ephemeris, that 41 is correct

This comet must have faded very rapidly, as Prof G van Biesbroeck made a careful search at Yerkes Observatory after receiving the telegram, but could not find it

Kwasan Circ, 181, notes that a 25 cm. photographic reflector, focal length 95 cm, has been installed at Kwasan for photographing comets and asteroids

Research Items.

The Eskimo.—Dr. Aleš Hrdlička reports, in the *Forty-sixth Report of the Bureau of American Ethnology* (1928–29), on a journey among the Eskimo of Alaska which lasted from May to September 1926. His object was to make an anthropological survey of the Eskimo, in the hope of filling in some of the gaps in our knowledge of this people which, up to the present, vitiate the conclusions which have been drawn as to their origin and affinities. The conclusions at which it has been possible to arrive are as follows. The Eskimo throughout their territory are one and the same people. The strain is fundamentally related to that (or those) of the American Indian. It is also undoubtedly related to the yellow-brown strains of Asia. In many respects the Eskimo are remarkably alike over their whole territory—in such characters as pigmentation, build of body, physiognomy, large brain, fullness of forehead, largeness of face and lower jaw, etc. They differ in details such as stature, form of head, and breadth of nose. The distribution of these is of some significance, but between east and west, where the extremes are found, there is a regular gradation without significant interruption. This is due not to admixture but to adaptation and differentiation. They suggest a moderate stream of people rooted in Asia of fairly broad but moderately high head, of good medium stature with a mesorhine nose, and other characteristics in common, reaching America from north-easternmost Asia after the related Indians, spreading along the coast until blocked by the preceding Indian tribes, and gradually modifying physically in adaptation to the environment and conditions. The evidence shows that, with the exception of some irregularities, the more highly differentiated and divergent the Eskimo becomes the greater the gap between him and his Indian neighbour. The facts point, therefore, to the original identity of the source from which the Indian, more particularly the latest branches, and the Eskimo were derived, and to the identification of this source with the palæo-Asiatic yellow-brown peoples of lower northern Asia. The differentiation of the Eskimo from this source must have proceeded over a fairly long time, and probably began on the northern coasts of Asia.

Supervision and Morale.—The *Journal of Industrial Psychology* (vol. 5, No. 8) gives an account of an experiment in supervision and morale by Mr. Elton Mayo, the object being to study the effect on employées of controlled changes in conditions of work. Six girl operatives doing standardised mechanical routine work for forty-eight hours a week were selected at random, and placed under test conditions for three years. A supervisor was installed to observe non-experimental influences. Then various changes were introduced, for example, segregation in test room, payment at special gang rate, rest pauses, five-day week, and so forth. The result showed a steady improvement measured in terms of output, which was continued even after resuming original conditions. Contrary to anticipation, it appeared that none of the controlled conditions was significantly responsible for the improvement, which appeared to be attributable to the mental attitude of the workers towards the supervisor. Periodic examinations of blood pressure and pulse rates revealed that a state of equilibrium, not one of constant effort, was that in which the best work was produced; this was equally true in the mental sphere, where the supervisor's tact and capacity for listening sympathetically were important. The details of the investigation, and relevant graphs given, are illustrative of the investigator's thorough work; but the experiment would have been of more scientific value had adequate control groups been described to the same extent.

The Creeper Fowl.—Further genetic experiments by Landauer and Dunn (*Jour. Genetics*, vol. 23, No. 3) confirm their hypothesis that the condition is lethal when homozygous. They have obtained creeper fowls from America, Scotland, Germany, and the Marquesas Islands. Crosses were made between these four strains which indicated that the same mutation is present in each. All the bones of the legs and wings are shortened in this type; the tibia is strikingly bent, and the fibula much enlarged. This condition is inherited as a simple dominant to normal. Breeding tests show that all creeper fowls are heterozygous; when mated together they give about 2 creepers : 1 normal, and about 25 per cent more embryos die during the first six days of incubation than in the case of outcrosses. These homozygous lethal embryos were identified. They show a great retardation in development on the third day of incubation, and a photograph is given for comparison with a normal three-day chick. A small number of these embryos, especially from crosses between different creeper strains or from outcrosses with normals, may develop nearly to the hatching time, but they show a condition of phocomelia similar to that known in man and other mammals. This is apparently the first time phocomelia has been observed in birds.

Scottish Tunicates.—Dr. H. Thompson, in his paper "The Tunicates of the Scottish Area. I." (*Fishery Board for Scotland, Scientific Investigations*, No. 3, 1930), has begun a systematic survey of the tunicates found in the area worked by the research vessels of the Fishery Board for Scotland, with special reference to the distribution and ecology of the species. He fully realises that a knowledge of the live animal with its eggs, larval and post-larval stages is of the greatest importance in classification, and the fact that he has been able in most cases to study each species in this way makes his work specially valuable. He also lays great stress on the proper preservation of the animal, a precaution often much neglected. Certain ascidians are important as fish food. For example, haddock in some districts, such as the Moray Firth, may feed on half a dozen species and at times almost exclusively on *Ascidia scabra*. An exact mapping of the distribution of all animals preyed upon by fish is very desirable. Natural barriers such as a definite change of temperature where two waters meet must affect both the fishes and their food. Indeed, the food is probably one of the most important factors in the distribution of fish. It is shown that there is such a natural barrier at or near a region to the south-east of Iceland, where within a few miles the temperature of the water undergoes a sudden change from boreal to arctic conditions. The haddock on each side of this barrier grow at quite different rates, and the change at any rate in the ascidian fauna is complete. The chief object of the work is to show which species are found under typical conditions. These 'critical' species, or 'test' species are specially studied, whilst others which are able to exist under more varied conditions are of secondary importance. The species are divided into boreal and arctic, and subdivided into boreo-arctic, north, south, east, and west boreal. The systematic part classifies the tunicates into orders, further classifies the sedentary forms, and describes the first order, Ptychobranchia, with the two families Molgulidæ and Pyuridæ.

Culture of Sponges and Oysters.—Two recent parts of Abderhalden's comprehensive "Handbuch der biologisches Arbeitsmethoden" (Abt. 9, Teil 5, Heft 4, Lief. 326, Heft 5, Lief. 333) continue the volume describing the culture and methods of rearing of marine plants and animals. Lief. 326 deals with sponges, cœlenterates, mollusca, and crustacea, whilst the oyster alone occupies Lief. 333. Only a few sponges have so far been reared from the egg, and it is very difficult to find suitable food for them. This is the main problem in the rearing of all marine animals, successfully solved for many forms by the diatom cultures of Allen and Nelson, but there still remain many invertebrates which in their first stages are too small to use these diatoms. In such cases minute flagellates and the active spermatozoa of *Fucus* are recommended. Unfortunately, however, the latter live scarcely longer than a day and so have to be frequently renewed, and cultures of flagellates are not so easy to maintain as cultures of diatoms. Much work is still needed on these points, although it is very interesting to see how much has already been done and how many invertebrates have been reared. Here, echinoderms come first and several species have been brought through all the larval stages on the diatom *Nitzschia*. These have already been described in a former part (Lief. 278). In the present sections both Dr. Hagmeier and Dr. Kandler say much about the rearing of molluscs, most of which must have very minute food in their early stages. Cœlenterates usually require animal food such as Copepod and Cirripede nauplii and other small planktonic forms. Crustacea, such as crab zoeæ, seem to prefer very young larval molluscs and may eat the planulæ of worms and echinoderms. Oyster larvæ form an ideal food for crab zoeæ, the older larvæ eating small crustacea or pieces of shrimp, prawn, or mussel. Vessels and aquaria of all kinds for rearing are fully discussed, and apparatus for collecting the various animals. Commercial rearing is also described, especially with regard to sponges and oysters.

A Natural Species-Hybrid in the Genus *Geum*.—A careful study of the well-known hybrid between *Geum urbanum* and *G. rivale*, which goes under the name of *G. intermedium* and has long been recognised as a natural species hybrid, has been made by E. M. Marsden-Jones (*Jour. Genetics*, vol. 23, No. 3). By crossing the two species experimentally the F_1 generation was found to be practically uniform but not intermediate between them except in three characters. Six of the *rivale* characters were dominant, including the presence of plumose hairs on the styles, anthocyanin in the flowers, and the flowers pendulous, while two *urbanum* characters appeared in the majority of plants. The back-crosses of *intermedium* to both species have been studied, as well as the F_2 generation from the original and the back crosses. The evidence of segregation in many characters is clear; but simple Mendelian ratios were not obtained. The reciprocal crosses between *intermedium* and *urbanum* gave identical results: 4 plants were *intermedium*, 2 *urbanum*, and 88 very like *urbanum*. These hybrids also exhibited a new type of short plumose hair. When a plant of this back cross is selfed, segregation takes place in number of glands, colour of petals, and type of flowers. The back cross *intermedium* × *rivale*, on the contrary, when selfed, shows very little segregation. A colony of such plants was studied at Bradfield, Berkshire, on the River Pang, where this hybrid appears to have established itself and largely replaced *rivale*.

Exploration in East Greenland.—A small expedition aided by the Norwegian Government visited East Greenland in the *Veslekari* under the leadership of A. K. Orvin during the summer of 1929. The objects were largely scientific, and a certain amount of correction of the charts was accomplished between Sabine Island and Davy Sound. The results are outlined, in Norwegian, in *Norges Svalbard- og Ishavs undersökelser, Meddelelse*, No. 11, which also contains a map. One of the important aims of the expedition was to obtain a number of musk ox calves which were to be sent to Spitsbergen, where the musk-ox does not exist at present. In the absence of wolves in Spitsbergen the musk-ox should thrive well in places where grasses are fairly abundant in the vegetation.

Geology of Uganda.—The Annual Report of the Geological Survey of Uganda for 1929 contains many features of unusual interest, one of the most notable being a geological account of a journey from Lake Tanganyika to Entebbe, undertaken by A. D. Combe. A general description of the spectacular volcano Nyamlagira is given, with details of its behaviour during the visit made to its crater. Bombs of olivine-leucitite are recorded from a late Pleistocene volcanic area near Kichwamba, south of the Kazinga Channel. At the other end of the geological column, in the "green-grey rocks" of North Kavirondo, W. C. Simmons finds phonolites with andesites and rhyolites. These ancient lavas are pre-Karagwe Ankolian in age and may correspond with the Ventersdorp of South Africa. Not far away there are phonolites of later Tertiary age. Simmons also adds to his previous contributions some further notes on the petrology of the Bufumbiro volcanic rocks, and points out that the total area over which leucitic lavas predominate is nearly 1500 square miles. A general paper on this important volcanic field and on the nature of its rocks appears in the *Geol. Mag.*, Nov. 1930. Detailed work is in progress, the results of which will be published in a forthcoming memoir. Other research notes in the report record seismic tremors connected with an epicentre near Ruwenzori; the occurrence of nepheline and melilite bearing rocks from near Mount Elgon; heavy mineral suites of Uganda granites; and archæological discoveries of three ages on a site near Port Bell. The report is enriched by a clearly designed and well printed provisional geological map of the Protectorate. The Director, Mr. E. J. Wayland, is to be congratulated on the solid record of achievement that is summarised in this very welcome map.

Carboniferous Rocks of Hook Head.—L. B. Smyth (*Proc. R. Irish Acad.*, 39 B, p. 523; 1930) describes the zonal characters of the Lower Carboniferous (Tournaisian) of the promontory ending in Hook Head, co. Wexford. The Carboniferous rests conformably on the Old Red Sandstone and includes the Cleistopora zone ($K1$, $K2$), the Zaphrentis zone ($Z1$, $Z2$, γ), and the Caninia zone ($C1$, $C2$). The succession closely resembles that found in Pembrokeshire. The echinoids, of which beautifully preserved specimens were obtained by collectors in the last century, appear to have come from the zones $C1$ and $C2$. In the section on palæontology some new species of corals and brachiopods are described.

Artificial Production of γ-Rays.—W. Bothe and H. Becker report in the *Zeitschrift für Physik* for Dec. 3 that a number of light elements—lithium, beryllium, boron, fluorine, magnesium, and aluminium—emit γ rays when bombarded by α-particles. The effect is apparently similar to artificial disintegration with liberation of protons, since the efficiency of production of the γ rays is about the same as that of protons, and the absorption coefficient of the radiation

from boron and beryllium—the latter being the most efficient radiator—about that of the hardest γ-rays from the common radioactive bodies Liberation of protons and emission of γ-rays do not, however, run parallel, nitrogen, for example, gives relatively large yields of protons, but no γ-rays, whilst beryllium gives strong γ-radiation, but is otherwise very stable The hardness of the radiation does not appear to be much affected by the speed of the α particles by which it is excited, and the radiation from boron, at least, is emitted about equally well in forward and backward directions The existence of a hard γ-radiation from polonium, the source of α rays for these experiments, is also reported

A Possible New Spectrum of Helium—In the issue of *Die Naturwissenschaften* for Jan 9, Dr W Grotrian has given a critical summary of Rosenthal's theory of the lines of the solar corona, the principal remaining spectrum of uncertain origin Rosenthal has suggested that these come from neutral helium atoms, in which both electrons have been displaced from their most tightly bound positions, with one always in the orbit next to the innermost On general grounds it would be expected that this system should give rise to a spectrum closely similar to the ordinary arc spectrum of this element, with corresponding lines displaced to the violet This is in fact what is observed with the coronal spectrum, the lines of which can be associated, with little forcing, with strong arc lines which are well known from laboratory work The objections raised by Dr Grotrian to this are serious, but not insuperable, as he recognises by characterising the theory as the first meriting really careful consideration, that the energy of the excited atoms is far in excess of that required for ionisation is only an extreme instance of what has been already established in several spectra obtained from laboratory sources, whilst the absence of the normal helium arc lines and the apparent occurrence of a state of the atom forbidden by the Pauli principle may possibly be attributable to the special conditions of excitation and to a flaw in the theory of the helium atom Dr Grotrian mentions that Rosenthal is attempting to obtain these lines from a discharge through pure helium, but whether this proves practicable or not, it should be possible to test his hypothesis by calculation of the energy of the helium atom in doubly excited states

Thermodynamic Properties of Fused Salts—Three papers in the December number of the *Journal of the American Chemical Society*, by J H Hildebrand, E J Salstrom, and A Wachter, describe experiments on the electromotive forces of concentration cells with fused salts Solutions of lead chloride in lead bromide, lithium bromide in silver bromide, and lead chloride in zinc chloride were used, with suitable electrodes The results show that the variations of electromotive force cannot be explained on the assumption of complete ionisation of the salts, although the authors prefer to consider them from the point of view of the change of interionic forces due to the substitution of one ion by another In the case of lead bromide and lead chloride, for example, a change in the interionic forces due to the replacement of the bromide ion by the smaller chloride ion is assumed The data so far obtained do not allow of a quantitative treatment on these lines, which will be attempted later

Lipase in Olives—It has been known from ancient times that olives, after being gathered or allowed to fall from the tree, are subject to a fermentative process which exercises a deteriorating influence on the oil afterwards obtained Experimental results published by Pantanelli and Verdesca in the *Rendiconti* of the Naples Academy of Physical and Mathematical Science for January June 1930 show that this process consists in acidification of the fatty matter owing to the action of a lipolytic enzyme which accelerates the scission of the glycerides into free fatty acid and glycerol with absorption of water The activity of this lipase increases rapidly as the cellulose structure of the fruit is destroyed by the pressing During the treatment of the olives, the enzyme is transferred from the aqueous magma to the oil, and the more highly acid the oil at the time of crushing, the richer is it in lipase and the more prone to become more acid The hydrolysis of the fat is related to the presence of moisture, which remains emulsified during the operations, and, apart from this, is proportional to the amount of glycerol already formed Hence, the factor determining the course and the intensity of the acidification is the glycerol, as it is the means of introducing water and lipase into the oil

Egg Albumin—The December number of the *Journal of the American Chemical Society* contains two papers on egg albumin The first of these, by J B Nichols, gives the results of ultra centrifuge experiments on crystallised, electro dialysed egg albumin The diffusion constant is abnormal, being six tenths of the value calculated from the sedimentation constant ($4\ 06 \times 10^{-13}$ cm per sec at 30°) and the molecular weight (34,500) The molecule is spherical and of radius 2 17 mμ, it is practically identical in size and mass with that of Bence Jones protein, although entirely different in chemical composition At a *p*H value of 1 16 in 0 1 *N* hydrochloric acid egg albumin is completely denatured and forms a gel, the mean size of the gel clumps corresponding with about seven molecules per particle after three hours The second paper, by Sjogren and Svedberg, is on the *p*H stability region of egg albumin Crystallised electro dialysed material was used, about three months old In the *p*H range the protein is stable and the ultracentrifuge gave a homogeneous molecular weight of 34,200 Below *p*H 4 and above *p*H 9 some of the molecules split into a non centrifugible substance At *p*H lower than 3 the sedimentation increases, indicating aggregation, above *p*H 9 it decreases, indicating the breaking up of the whole material

Atomic Weights of Uranium Lead—Baxter and Bliss, in the December number of the *Journal of the American Chemical Society*, report the value 206 01 for the atomic weight of lead from Swedish kolm (a shale like material said to be an upper Cambrian sedimentary with trilobites) This is the lowest value ever formed, the next being 206 046 obtained by Hönigschmid and Horowitz for lead from Morogoro pitchblende No thorium was found in the kolm ash If Pb^{207} is the end product of the actinium series, on the basis of Aston's results, an atomic weight not less than 206 1 is to be expected for uranium lead In a second paper the same authors report the value 206 195 for lead from a specimen of uraninite from Ontario On the assumption that this is essentially free from ordinary lead, that the relation of Pb^{206} to Pb^{207} found by Aston in bröggerite material, 86 8 to 9 6, is that in which these isotopes are produced from uranium, and that the uranium equivalent of thorium in lead-producing power is 0 38, the average atomic weight of lead in the specimen of uraninite used is calculated as 206 23 The difference between this value and that found experimentally, 206 195, is far larger than the experimental uncertainty. The possibility that Aston's bröggerite lead was badly contaminated with ordinary lead is raised.

Problems of High Tension Overhead Electric Supply Systems

THE setting up of high tension overhead electric supply systems all over Great Britain has brought to the foreground many engineering and scientific problems, the solutions of which are urgently wanted One is the best design for insulators so as to avoid flashover, and another is the best way of preventing the vibrations of overhead transmission conductors In a paper read by Mr P J Ryle to the Institution of Electrical Engineers on Feb 5, both these problems were discussed and partial solutions given

Seven years ago, the Newcastle Electric Supply Co put into operation a 66-kilovolt line which is now nearly a hundred miles long It was soon found out that flashovers occurred in the strings of suspended insulators in industrial areas It was also discovered that they occurred oftener when the line was near a rocky coast than when it was in the neighbourhood of a sandy beach Probably the salt spray was the cause The number of insulators in the supports was increased from five to six, but this had little effect The main cause was traced to the deposits on the insulators Similar troubles have occurred in Germany near lignite (brown coal) power stations, and mention was made of a complete 110 kilovolt system which had to be roofed over owing to the dust from an adjacent lignite station Deposition on the porcelain surfaces is favoured by hollows in the insulator which are protected from the wind and rain Several firms in Great Britain have installed fog and dirt chambers for the purpose of carrying out full voltage tests on these insulators, under the most severe conditions The solution favoured is that facilities should always be available for shutting down main transmission lines once a year for a thorough inspection and for the cleaning of the insulators This could be done at a period of light load

Vibration probably occurs on every transmission line in the world, but breakdowns due to it do not often occur In Mr Ryle's paper the swaying of the conductor as a whole, which is evident in a strong wind, was not discussed, nor was the 'dancing' of conductors which sometimes occurs when rapid changes in the load or the temperature occur He dealt with phenomena analogous to the humming of telephone and telegraph wires, the transverse vibration of aeroplane stay-wires which caused difficulty in the early days of flying, the regular swaying of tall factory chimneys across the wind, and the vibration of underwater towing cables The 'speed-wobble' on motor cycles, which is due to the front and rear halves of the front wheel tending to vibrate in opposite directions, is probably due to a similar cause

The cause of the vibration, which is, at least initially, in the plane perpendicular to the direction of the wind, is attributed to the instability of a type of air flow in the wake of a cylindrical body The eddies seem to set up alternating forces transverse to the wind, which tend to initiate and maintain vibration, especially when their period coincides with a natural period for transverse vibration Little is known at present of the various types of damping forces due to the air, elastic hysteresis in the wires and in the lattice towers Luckily, there is, in general, little probability of vibrations ever building up to large amplitudes, as a very slight change in the wind velocity alters the resonant harmonic Experience has shown that the vibrations increase the larger the conductor and the more tightly it is strung Wind velocities of between two and twenty miles per hour are the most effective in producing these vibrations Some guiding principles were given for the design of damping devices

Indian Lac Research.

THE Annual Report (to Mar 31, 1930) of the Indian Lac Association for Research gives evidence that the important work carried on at this Institute is making steady progress The Institute and its connecting buildings are almost completed, and the staff, which now numbers 24, has had added to it Dr R W Aldis, in charge of the physico-chemical section As the director and bio chemist, Mrs Dorothy Norris, states, "it will now be possible to examine closely each stage of the ordinary process of lac manufacture, with a view to checking waste and devising improvements"

For those interested in lac and its development and economics this report will well repay a study Briefly, the work at the Institute resolves itself into the following main features The formation of plantations of species of trees which are considered likely to produce the largest amount of lac The chief factors under study are (*a*) the sylviculture and requirements in soils, etc, of the different species and their success under varying climatic conditions, (*b*) the success attainable by employing manures in the plantations, (*c*) the chemical factors affecting or encouraging the growth of the trees on different soils, (*d*) the chemical differences in the sap of the twigs and their influence on the lac insect itself, (*e*) the seasonal variations in host plants of the lac insect, also under investigation in the laboratories of the bio-chemist and assistants, together with analysis work of lac obtained from different host plants

The other important section of the Institute is that on entomology, under Mr P M Glover, helped by a staff of nine Mr Glover divides the work of his branch into two groups—first, the bionomics of the lac insect, *Laccifer* (*Tachardia*) *lacca*, and secondly, the investigation of the insect enemies and friends of the lac insect, the latter including the enemies of lac host trees It is impossible to follow Mr Glover in the interesting account of the problems with which he is faced As an example it will be sufficient to state that one well known lepidopterous (Noctuidæ) pest, *Eublemma amabilis*, passes through six life cycles in a year and eight days, to indicate the complications which insect depredators add to the study of this valuable lac insect and its habits, and to the best methods of propagation and so forth The theory that ants preyed upon the lac insect and consequently diminished the crop is now officially disproved in the majority of cases investigated

That the work of the entomological branch, however, is of the greatest importance is supported by Mr Glover's statement on the damage done by pests "The annual stick lac production of India, including Burma and Assam, is in the neighbourhood of 1,700,000 of maunds [1 maund = 80 lb] valued at about Rs 6,80,00,000 The average percentage damage by insects to lac crops is 60 per cent; this means that the annual lac crop is roughly one-third of the hypothetical undamaged crop, giving an annual loss due to insect damage of Rs 13,60,00,000" It will be apparent that the study of the pests of lac and methods of combating them should well repay the sums expended on the research undertaken with this object in view

Fossil Wood from the Bituminous Sands of Alberta.

SINCE 1913 the Mines Branch of the Department of Mines of Canada has been carrying out, under the direction of Mr S C Ells, an extensive investigation of the bituminous sands (McMurray Tar Sands) of Northern Alberta In a long communication to the Editor, dated Jan 12, Mr Ells directs attention to the presence of fossil wood in these sands The discovery of fossil wood on the Ells River was first recorded by him in 1914, and later similar wood was obtained in shaft sinking operations near McMurray (*Report* 632, Mines Branch, Dept of Mines, Canada, p. 55, 1925) Many of these specimens and others found later were sent to Prof I W Bailey at Harvard University, who reported that one of the fossil woods belongs to some gymnosperm, not found growing in North America at the present day, which closely resembles in its wood structure *Sciadopitys*, the parasol pine of Japan Another he refers to the conifer *Keteleeria*, which is found in China and Formosa at the present day, while a third appears to belong to the type of wood called *Xenoxylon*, which has been found in Jurassic rocks These three types, which may be referred to the three form genera of fossil woods, *Phyllocladoxylon*, *Protopiceoxylon*, and *Xenoxylon*, from other records appear to have a stratigraphical range from the Jurassic onwards

The fossil wood, which is found in the McMurray Tar Sands in various sized fragments, up to trunks at least 40 ft in length, must have been transported, according to Mr Ells, by water, and afterwards embedded in sand The sands at a later date became saturated with asphaltic base petroleum, which impregnated and preserved the cellular structure of the wood

Other samples of these fossil woods were examined at the University of Alberta by Prof F J Lewis, who, in a letter to the Editor, dated Dec 23, 1930, states that some of the fragments of wood belong to the form genus *Cupressinoxylon*, a type of wood found in the cypress and several other conifers, living and extinct He also mentions that some of the wood is "Cordaitean in character with centripetal xylem" Without fuller details and photographs, it is impossible to express more than a guess as to the significance of these discoveries and identifications Wood of Cordaitean type with centripetal xylem is what one might have expected to find in Palæozoic rocks On the other hand, *Cupressinoxylon*, *Phyllocladoxylon*, *Protopiceoxylon*, and *Xenoxylon* would suggest a Mesozoic age for the beds This is consistent with the fact that the beds immediately below are found to contain a Jurassic flora It is to be noted that all the woods apparently belong to coniferous trees and there are no Angiosperms represented in the collection This negative evidence is in favour of a Jurassic or very early Cretaceous age, before the advent of the Angiosperms According to Mr Ells, the discovery in the beds of two shells, of a *Campeloma* and a Melanoid belonging to the genus *Pachymelania* on Hangingstone River gives an additional clue to the age, for *Campeloma* has hitherto not been found in beds older than the basal part of the Cretaceous in America

These various pieces of evidence, though not of much weight taken separately, point, on the whole, to an early Cretaceous age (or perhaps late Jurassic age) for the bituminous sands in which the fossil woods are found However, until these fossil woods have been identified specifically and compared carefully with similar woods of known geological age, they are of little value as stratigraphical indices One looks forward to the appearance of an adequately illustrated memoir on these interesting finds The specimen of "Cordaitean wood" may be of considerable botanical interest

Cancroid Crabs of America.

MISS MARY J RATHBUN has completed a third part of her series of handbooks on American crabs in a work entitled "The Cancroid Crabs of America of the Families Euryalidæ, Portunidæ, Atelecyclidæ, Cancridæ, and Xanthidæ" (Smithsonian Institution, United States National Museum, *Bulletin* 152, 1930) This monograph is on the same lines as those previously published, namely, "The Grapsoid Crabs of America" and "The Spider Crabs of America", and is equally valuable and well got up Not only does it enable one to identify the American crabs, but also it helps all carcinologists with its detailed and carefully prepared classification, synonymy, and tables of distribution

The Smithsonian Museum has recently been much enriched by large collections of crabs from South America obtained by Dr Waldo L Schmitt during his two series of explorations under the auspices of the Walter Rathbone Bacon scholarship These, together with several exchanges from various museums, make the South American collections very valuable Further investigations at the Tortugas and neighbourhood for the Carnegie Institution by Dr Schmitt and Mr Clarence R Shoemaker in co-operation with Dr William H Longley, in charge of the Laboratory, have contributed much that is of interest, and collections have been added from the University of Southern California and the California Academy of Sciences

A specially valuable find was a specimen of the extremely rare little crab *Metopocarcinus truncatus* Stimpson, of which the type is not extant, and this is the only one known to exist in any collection It is recorded from Cape St Lucas, Lower California, Mexico, and Valparaiso, Chile

It is with some reluctance that we call the common green crab *Carcinides* instead of *Carcinus*, but this alteration and the substitution of Euryalidæ for Corystidæ, to quote only one of many changes, are sound from the point of view of the International Rules of Nomenclature, as is also the restriction of the genus *Portunus* to those forms with nine lateral teeth each side of the carapace Mr Richard Palmer in his paper, "A Revision of the Genus *Portunus* (A Milne Edwards, Bell, etc)", in the *Journal of the Marine Biological Association*, N S, vol 14, No 4, 1927, discusses the subject with much fairness, and one cannot help hoping that the general opinion will be in favour of keeping our British forms with five teeth each side of the carapace in the genus *Portunus*

Nothing at all is said of the larval forms of any of the crabs, although now a good deal is known which is helpful in classification This is, of course, in keeping with the other volumes, but it is to be hoped that the time is not far distant when larval characters will be as important as any of those of the adult, and that the structure of larvæ and adults together will form the basis of all systematic work

The volume consists of 593 pages, containing many excellent figures, besides 229 beautiful photographic plates

The Atlantic Cod and its Races *

DR JOHS SCHMIDT'S happy intuition as to the choice of successful investigations is again exemplified by his latest memoir Here he has examined samples of cod from all over its north Atlantic region of distribution In each fish (about 20,000 in all) the numbers of vertebræ and the numbers of rays in the second dorsal fin have been counted The results are fully displayed in a series of tables and charts They are very remarkable and unexpected

The highest numbers of vertebrae (54 to 55 46) are found in the cod taken from the sea off the coasts of Newfoundland and Labrador, and the lowest numbers are those found in Irish Sea fish, we may summarise these results

Newfoundland Labrador	54 55 46 Vert	Temperature		0° 5°
Greenland, Iceland East Baltic	52 41 53 09	„	„	5° 10°
North from Scotland, North Sea	52 52 4	„	„	5° to > 10°
Rockall, West from Scotland Irish Sea	51 47 51 90	„		10° 15°

Thus there is an undoubted correlation between the values of a certain morphological character and the general sea temperatures throughout the whole region inhabited by the cod Dr Schmidt gives other examples of similar correlations (1) in respect of the number of rays in the second dorsal fin of the cod, (2) the numbers of vertebræ in both winter and summer spawning herrings, and (3) the numbers of vertebræ in the fish *Zoarces* The latter investigation was the subject of a previously published memoir and it is very interesting in a single fiord, for example, the numbers of vertebræ in the fish diminished regularly from the shore regions immediately outside the fiord to those at its inner extremity

Returning to the cod results, it is clear that there are local races with relatively restricted regions of distribution, and that there cannot be much intermigration between these localised regions This probably applies also to the distribution of the herring The conditions responsible for these segregations require investigation, and Dr Schmidt only touches this question Probably there is 'direct impression', or action, upon the developmental factors of the fish, during some 'critical period', by the external physical factors Certain experimental results actually suggest this, but, obviously, much more investigation is required Such a conclusion does not rule out the hypothesis that differences between the races are of a "hereditary, genotypical nature" It is, on the whole, improbable that the differences are due to selection of the variates Dr Schmidt's memoir is a model of clear and accurate exposition, and the results themselves are of unusual interest J J

* *Comptes-rendus des travaux du Laboratoire Carlsberg*, vol 18, No 6 'Racial Investigations, 10 The Atlantic Cod (*Gadus callarias* L) and Local Races of the same By Johs. Schmidt Pp 722 + 10 plates

University and Educational Intelligence.

CAMBRIDGE —The Appointments Committee of the Faculty of Biology "B" has reappointed Dr W E Dixon to be University lecturer in biochemistry, and has appointed Mr E T C Spooner, of Clare College, and Mr A A Miles, of King's College, to be University demonstrators in pathology

The following Grace has passed the Senate "That the Degree of Master of Arts, *honoris causa*, be conferred upon Ebenezer Everett, for many years assistant to Professor Sir J J Thomson at the Cavendish Laboratory"

THE Cecil Peace Prize of £100, which is offered yearly for an essay on some subject connected with the maintenance of international peace, to any undergraduate of any university or university college in Great Britain or Northern Ireland who has not attained the age of twenty five years, has been awarded to Mr G G Thomson (University of Edinburgh) for 1930, with Freda Marrison (University College of Swansea) as *proxime accessit*

THE annual meeting of the Association of Technical Institutions will be held in the Merchant Taylors' Hall, Threadneedle Street, London, E C 2, on Friday and Saturday, Feb 27 and 28 The proceedings will commence at 11 A M on Feb 27, when the chair will be taken by the president, the Right Hon Lord Eustace Percy, M P, who will introduce the president elect, Major General Sir Philip Nash Following this, an address will be given by Principal B Mouat Jones, on "Technical Education in Russia" Members and guests of the Association will afterwards be received by the Master and Wardens of the Merchant Taylors' Company, and luncheon will be served in the Company's Hall Friday afternoon and Saturday morning will be devoted to the reading of papers by Mr G H Gater, Chief Education Officer, London County Council, on "A Descriptive Account of Technical Education in London", Mr Comyns Carr, on "Industrial Administration", Principal J A Todd, of the City School of Commerce, Liverpool, on "National Certificates in Commerce", Mr J W Ramsbottom, Director, City of London College, on "Commercial Education in America"

THE report of a consultative committee, under the chairmanship of Sir W H Hadow, which was appointed by the Board of Education to inquire into the courses of study suitable for children (other than children in infants' departments) up to the age of eleven years, with special reference to the needs of children in rural areas, has just been published under the title of "The Primary School" (London H M Stationery Office, 1931 2*s* 6*d* net) The report may be regarded as the logical complement to the consultative committee's report on the "Education of the Adolescent" (1926) (Hadow Report), dealing as it does with the upper stage of primary education This important period in the development of children has, up to the present, been comparatively neglected by physiologists and psychologists Recognising this fact, the Consultative Committee obtained memoranda on the physical growth and mental development of children up to the age of eleven years from Prof H A Harris and Prof Cyril Burt The data contained in these memoranda (Appendices 2 and 3) and in other evidence obtained from various specialists are discussed in Chaps 2 and 3 Chap 4 deals with administrative problems, while Chap 5 discusses questions of the internal organisation of primary schools Chap 6, on the problem of retarded children at the primary stage of education, dealing especially with the chief causes of retardation, should be of considerable interest to teachers and administrators Chap 7 gives the views of the Committee on the general problem of the curriculum for children up to the age of eleven The sections on the "Study of Nature", and the memorandum on the anatomical and physiological characteristics and development of children between the ages of seven and eleven, by Prof H A Harris, and that on the mental characteristics of such children, by Prof. Cyril Burt, are of special interest

Societies and Academies.

LONDON

Royal Society, Feb 12 —**J Cohen, K Cooper**, and **P G Marshall** Some aliphatic and aromatic amino derivatives of α-quinoline methodide Many of the amino and acylamino compounds obtained by the condensation of derivatives of α-methyl quinoline with nitrosoarylamines possess active antiseptic and in some cases mild trypanocidal properties Sub stances obtained by attaching a basic aliphatic or aromatic side chain directly to the α carbon of the quinoline nucleus exhibited no marked antiseptic or trypanocidal character Diamino compounds of ali phatic and aromatic series with basic groups at both ends of the chain did not exhibit the expected anti malarial action —**C H Browning, J B Cohen, S Ellingworth**, and **R Gulbransen** The antiseptic and trypanoidal action of certain styryl and anil benzthiazole derivatives The anil benzthiazole de rivatives are relatively weakly antiseptic for *Staphylo coccus* and *B coli*, as compared with the quinoline analogues, which are highly active in this respect Several benzthiazole styryl compounds have pro duced cure of mice infected with *Trypanosoma brucei*, and the same relationships between chemical con stitution and trypanocidal action have been found to hold as in the styryl quinoline series Thus the maxi mum effect is produced when one nucleus contains a basic group and the other an acetylamino group The anil benzthiazole series, in general, possesses some trypanocidal action, but cure has only excep tionally been produced

Physical Society, Jan 16 —**L C Martin** The theory of the microscope The paper examines the diffraction effects produced by (*a*) two adjacent apertures, and (*b*) a series of apertures in an opaque screen situated in the focal plane of a lens system, when the illuminating system is projecting the ele mentary image of a point source of light into this object plane The diffraction effects and geometrical resolving power of the grating are shown to be inde pendent of the concentration of the light in the object plane, they depend rather on the number of aper tures free to transmit light The theory is then ex tended to the case where the illumination of the object is produced by a source of finite area —**J H Vincent** Further experiments on magnetostriction oscillators at radio frequencies The coil surrounding the bar can be in either branch of a simple tuned anode circuit When the bar coil is in the inductive branch the circuit may be operated as a series or parallel arrangement, in the latter case the direct plate current does not pass through the inductive branch of the fly-wheel circuit The variation in either the anode or the grid current can be used to indicate resonance Comparative experiments with corronil, nickel, and glowray suggest that glowray is the most suitable of these materials for high-frequency oscillators —**S Butterworth** and **F D Smith** The equivalent circuit of the magnetostriction oscillator The equivalent electric circuit is developed and ex pressions for its elements in terms of the fundamental constants of the material are given The circle diagram of impedances is deduced, and the modifying effects of eddy currents and hysteresis are investi gated Some simple geometrical relations between the vectors in the diagram are derived An experi mental investigation of the resonant radial vibrations of solid and laminated nickel rings verifies the theo retical deductions For nickel in the annealed state, $\lambda = 1\ 76 \times 10^4$ and $\kappa = 22\ 1 \times 10^4$ at a point on the curve corresponding to $H_0 = 14\ 5$ gauss

Geological Society, Jan 28 —**J. F N Green** The South West Highland sequence The present suc cession near Ballachulish can be paralleled in detail with Islay On attempting to apply the result to the neighbouring areas of Glencoe, Onich, and Cuil Bay, several amendments to current views are suggested The evidence supporting these amendments is given The three areas, Islay–Jura, Ballachulish–Appin, and Tayvallich–Loch Awe, are regarded as complex synclines of correlated rocks Between these synclines appear grey calcareous phyllites Between the phyllites and the flags or discontinuous quartzite occur shallow water beds, composed essentially of quartzitic conglomerate and calcareous sandstone, accompanied usually, but not always, by black slate

PARIS

Academy of Sciences, Dec 22 —**P Vincensini** A property relating to the deformation of surfaces —**Bertrand Gambier** Voss Guichard surfaces —**J Herbrand** A new demonstration and generalisation of a theorem of Minkowski —**Kourensky** The general isation of the Poisson Jacobi parentheses —**Henri Mineur** The K terms of the radial velocities When the mean radial velocity of the stars is developed in a series of spherical functions, the development con tains a constant, called the K term, which cannot be explained by the movement of the sun, or by the rotation of the whole of the stars The K terms for stars of known radial velocities have been calculated, classifying by types of spectra, by the distances from the sun, and by galactic latitudes —**André Lallemand** The photometric study of the solar corona for radia tions in the red and infra red The relation between the brightness (B) of an element of the corona and its distance from the sun (p) has been found to be

$$\log B = \alpha p + \log B_0$$

For a given wave length, α is constant and inde pendent of the region explored —**G C Moisil** The systems of Dirac equations of elliptical type —**Marcel Chopin** An apparatus for measuring the surface tensions of liquids The apparatus described and illustrated can be used for measuring surface tension in absolute values with quantities of liquid of the order of 0 15 c c —**J Basset** and **R Dupinay** The compressibility of nitrogen and of hydrogen at ultra pressures of 5000 atmospheres 1 c c of hydrogen at 1000 kgm /cm ^{2} becomes 0 456 c c at 5000 kgm /cm ^{2} 1 c c of nitrogen at 1000 kgm /cm ^{2} becomes 0 610 c c at 5000 kgm /cm ^{2} Apparatus is under construction for studying gases at pressures of 25,000 atmospheres —**P de la Gorce** The realisation of a resistance for measurements at very high voltages Description, with diagram, of an arrangement in use at the Labora toire central d'électricité for a steady load at 150 kilovolts —**P Girard** and **P Abadie** The hypothetical existence in water of resonators of Hertzian frequency Measurements of the dielectric constant of a solution of sodium silicate of concentration $1\ 5 \times 10^{-4}N$ for wave lengths between 50 18 cm and 60 28 cm have not proved the existence of dispersion bands, and the experiments of Weichmann and of Frankenberger cannot be confirmed —**Georges Fournier** The graphi cal calculation of the magnitudes connected with the electron in motion —**Z Zajac** The fluorescence of excited mercury atoms —**Louis Goldstein** The introduction of the exchange in the statistics of a gas of electrons —**André Guilbert** The thermal phenomena produced along hysteresis cycles —**Marcel Dufour** The representation of the astigmatic pencil and the auxiliary straight line of Mannheim —**J Dourgnon** and **G Waguet** Theorems relating to the brilliancy of secondary sources —**Constantin**

Salceanu The magnetic rotatory polarisation of organic substances liquefied by fusion Measurements are given of the magnetic rotation (field 36,000 gauss) of naphthalene and of β-methylnaphthalene for varying temperatures above the melting points of these substances the results are compared with those deduced from Mallemann's theory —**R de Mallemann and P Gabiano** The magnetic rotatory power of hydrocarbons in the gaseous state Special attention has been paid to the purification of the gases examined, fractional distillation being used where possible Data are given for the first six hydrocarbons of the paraffin series —**Charles Dufraisse and Léon Enderlin** *Contribution to the study of the reversible oxidisability of organic substances* the thermochemistry of the oxidation of rubrene The determination of the heats of combustion of rubrene and its oxides, proves that there is a loss of 23 calories when passing from rubrene to its dissociable oxide —**E H Buchner** The vapour pressure of jellies The author has been unable to confirm the results obtained by Paul Bary on the vapour pressure of jellies, and hence thinks it unnecessary to discuss the theoretical explanation given by the latter —**Paul Bary** The vapour pressure of jellies Reply to E H Buchner —**Marcel Godchot and Mlle G Cauquil** The dispersion of refraction of cyclanic hydrocarbons The refractive indices (n, n') for two wave lengths (λ, λ') have been determined for 23 hydrocarbons of the cyclo pentane, cyclo hexane, cyclo heptane, and cyclo octane series The specific dispersion $(n - n')/d$, where d is the density taken at the same temperature as the optical observations, shows certain regularities —**G Mahoux** The influence of high frequency oscillations on the treatment of metallurgical products When a steel containing nickel, chromium, and molybdenum was heated to 500° C for nine hours in a current of gaseous ammonia, its hardness and resilience are not appreciably changed Under similar conditions, but with the test piece submitted to high frequency oscillations, the hardness is increased to about three times the original value Other steels show similar changes —**Léon Guillet** Remarks on the preceding communication The importance of these researches is emphasised and the necessity for further work indicated —**Augustin Boutaric** A method of following the variation of the number of particles in the course of the evolution of a colloidal solution Application to blood serum The change in the number of particles in suspension can be followed by the comparison of measurements of viscosity and the optical density —**P Laffitte and M Patry** The detonation of explosive solids —**M Paić** The fusion diagram of the systems $HgBr_2 - HgSO_4$ and $HgCl_2 - HgSO_4$ —**Edouard Urbain** The acid magnesium potassium carbonates and magnesium ammonium carbonates —**A Travers and Franquin** The estimation of piperidine in a mixture of pyridine and its higher homologues —**J Wyart** The dehydration of heulandite studied by means of X rays —**L Royer** The possible orientation of cubical crystals deposited on a sheet of mica —**F Dupré la Tour** The polymorphism of the saturated dicarboxylic fatty acids as a function of the temperature —**R Weil** The peculiarities of amethysts and quartz rich in solid inclusions —**Albert Michel-Lévy** Crushed granulite and ante Stephanian mylonites at the north-east of the mountains of Espinouse —**Maurice Blumenthal** The transversal extension of the betic mass in the "Hoya de Malaga" —**Henri Termier** The existence of Caledonian folds in central Morocco —**J Devaux** The photometric study of the penetration of solar radiations in the interior of the Pyrenees glaciers—**J Thoulet** Aerial columns and submarine liquid columns —**R G Werner** The formation of lichens —**Maurice Hocquette** The evolution of the nucleus in the cells carrying bacteria of the nodules of *Ornithopus perpusillus* during the phenomena of infection and of intracellular digestion —**Marc Simonet** The cytological study of some hybrids of *Iris* —**Charles Pontillon** Variations in the unsaponifiable matter and lipoid phosphorus of *Sterigmatocystis nigra* as a function of the mineral composition of the culture fluid —**Paul Guérin** The development of the egg and polyembryony in *Erythronium dens canis* —**J R Denis and P Paris** The influence of light on the free plankton of fresh water —**M Bridel and C Charaux** Frangularoside, a new rhamnoside of recently dried alder buckthorn bark It is the custom to store this bark for a year before sale, and Schwabe has stated that franguloside does not exist in the fresh bark The authors confirm this view, since on applying the method which extracts 25 grams of franguloside from a kilogram of commercial bark, a different rhamnoside is obtained, to which the name frangularoside is given Hydrolysis of this new compound gives 41 per cent of rhamnose —**G Nicholas and Mlle Aggéry** New observations on *Phyllosticta Daphniphylli* and the increase of its action by bacteria —**Mme Lucie Randoin and Mlle Andrée Michaux** Variations in the proportion of chlorine in the blood serum and the variations of the chloride elimination in the course of acute experimental scurvy —**H Bierry** Protein, sugar and animal species —**L Bugnard and C Soula** *Cholesterolic regulation* —**C N Dawydoff** The post-embryonic development of the annamite *Cœloplana* The organisation of the larva —**E Roubaud** The existence of genetically distinct biological races in the common mosquito, *Culex pipiens* —**R Fosse, A Brunel, P de Graeve, P E Thomas, and J Sarazin** Application of the seed of *Soja hispida* deprived of uricase The qualitative and quantitative analysis of allantoin —**Jean Loiseleur** The state of the biochemical constituents, especially the proteins, in anhydrous solutions Proteins and other biochemical constituents are soluble in certain fatty acids, forming, in the absence of water, true solutions —**G Ramon** The production of the tetanus antitoxin —**Georges Fontès and Lucien Thivolle** Tryptophane and histidine deficiency regarded as contributing to Biermer's disease (progressive pernicious anæmia)

Melbourne

Royal Society of Victoria, Dec 11 —**J H Gatliff and C J Gabriel** Additions to, and alterations in, the Catalogue of Victorian Marine Mollusca Of the new records, ten are chitons, three bivalves, and twenty-two univalves, of which nine are included in the family *Turridæ* —**F Chapman and W J Parr** Notes on new and aberrant types of Foraminifera A new genus, *Heronallenia*, is proposed for some previously described species of *Discorbina* The genus is found fossil in the Oligocene of Muddy Creek, the Miocene of Batesford, and the Pliocene of England The recent specimens are recorded off the Falkland Islands, the Antarctic, New South Wales, and Japan The new genus, *Hofkerina*, has for genotype Howchin's *Pulvinulina semiornata*, and is a member of the family *Victoriellidæ* —**F Chapman** Occurrence of a fossil *Hydractinia* in Australia *Hydractinia thatcheri* is here newly described, from the Miocene of the Murray River Cliffs, South Australia It is quite distinct in specific structure from any previously described, and is the first occurrence of the genus in Australian rocks The perisarc is papillate and encrusts a once existing gasteropod shell —**W J Parr** Victorian and South Australian shallow water Foraminifera. One hundred and ninety four species and varieties are

recorded, including sixteen described as new Several usually warm-water species are found in Bass Strait, but not on the South Australian coast, while other species described from the Miocene of Victoria are now recognised for the first time as living in the same area

Official Publications Received.

BRITISH.

The South African Journal of Science. Vol 27 Being the Report of the Twenty eighth Annual Meeting of the South African Association for the Advancement of Science, Caledon, 1930, 7 July to 12 July Pp xlvi+620. (Johannesburg) 30s net

Journal of the Manchester Geological Association Vol 1, Part 2 1927-8 Edited by Laurance H Tonks. Pp 61 113 (Manchester) 7s 6d

Annual Report of the Indian Central Cotton Committee, Bombay for the Year ending 31st August 1930. Pp ii+118 (Bombay) 2 rupees

Air Ministry Aeronautical Research Committee Reports and Memoranda. No. 1305 (E 41) A Harmonic Analysis of the Torque Curves of a Single Cylinder Electric Ignition Engine when throttled to various Mean Indicated Pressures, with an Appendix on the Estimation of Forcing Torques in Multi-Cylinder Engines. By N S Muir and A Terry Pp. 14+11 plates 1s net. No 1334 (Ae 467) Wind Tunnel Experiments with Circular Discs. By L. F G Simmons and N S Dewey (T 2919) Pp 6+4 plates. 9d. net No 1337 (Ae 468) The Stresses in a Radially Spoked Wire Wheel under Loads applied to the Rim Part 2 Simplified Formulae and Curves By Prof A J Sutton Pippard and W E Francis. (T 2978) Pp 10+9 plates. 9d net No 1338 (Ae 469) Stalled Flight Tests on a Bristol Fighter fitted with Auto Control Slots and Interceptors By R P Alston and Pilots of Aerodynamics Flight, R.A E (T 2979) Pp 3+1 plate. 4d net. No 1339 (Ae. 471) Full Scale Experiments on High Tip Speed Airscrews —The Effect of Thickness of Section on Airscrew Performance By W G Jennings and A Ormerod (T 3002) Pp 6+8 plates 6d net No 1340 (Ae 472) Directional Stability of High Speed Aircraft By W G Jennings (T 2991) Pp. 4+17 plates 6d net No. 1315 (Ae 470) An Experimental Determination of the Intensity of Friction on the Surface of an Aerofoil By A Fage and V M Falkner (T 2936) Pp 24+13 plates 1s 3d. net. No 1360 Technical Report by the Accidents Investigation Sub Committee on the Accident to the Aeroplane G AAZK at Meopham, Kent, on 21st July 1930 Pp 92+27 plates 6d net. (London H M Stationery Office)

FOREIGN

Mémoires du Musée Royal d Histoire Naturelle de Belgique. Hors série Résultats scientifiques du voyage aux Indes orientales Néerlandaises de LL AA RR le Prince et la Princesse Léopold de Belgique Publiées par V van Straelen Vol 2, Fascicule 2 Süsswasserschwämme von Neuguinea. Von Walther Arndt Pp 12 Vol 2, Fascicule 3 Coelentérés hydropolypes Par E Leloup Pp 18+2 planches Vol 2 Fascicule 4 Scyphomedusen Von G Stiasny Pp. 12 Vol 2, Fascicule 5 Die Oligochaeten Von W Michaelsen Pp 26 Vol 3, Fascicule 1 Isopoda (excl Oniscoidea et Epicaridea), par H F Nierstrasz, ii Isopoda Epicarides, par H F Nierstrasz et G A Brender à Brandis Pp 17 Vol 3 Fascicule 2 Parasitic Copepoda. By W Harold Leigh Sharpe Pp. 11+5 plates Vol 3 Fascicule 3 Cirripedes By Dr C. A Nilsson Cantell Pp. 24 Vol 5, Fascicule 1 Batraciens Par Gaston Fr de Witte Pp. 8 (Bruxelles)

University of California Publications in American Archaeology and Ethnology Vol 29, No 2 A Crow Text, with Grammatical Notes. By Robert H Lowie Pp 155 175 (Berkeley Cal University of California Press London Cambridge University Press) 30 cents

Ministry of Agriculture, Egypt Technical and Scientific Service. Bulletin No 97 Some Climatic Relations of the Date Palm in Egypt. By Ahmed K M Ghamrawy Pp. ii+23 5 P T Bulletin No 100 Developments of the Existing System for Seed Supply of Cotton in Egypt By Dr W Lawrence Balls Pp 11+8 plates 5 P T (Cairo Government Press.)

Conseil Permanent International pour l Exploration de la Mer Rapports et procès verbaux des réunions Vol 67 Reports of the Proceedings of a Special Hydrographic Meeting held on May 27th, 1930 in Copenhagen Pp. 99 4 00 kr Vol 68 Fluctuations in the Abundance of the various Year-Classes of Food Fishes Reports prepared by Special Reporters nominated by the Council and indicating the Main Results brought out by the Papers read at the Biological Meeting of London in 1929 Pp 115 4 50 kr Vol 69 Statistiques biologiques et considérations sur la population harenguière de la Manche orientale et du sud de la Mer du Nord Pp 12 0 75 kr Journal du Conseil Vol 5 No 3, Décembre Rédigé par E. S Russell Pp 285-454 (Copenhague Andr Fred Høst et fils)

Diary of Societies.

FRIDAY, FEBRUARY 20.

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Department Lecture Room, Imperial College of Science and Technology), at 11 30 A.M.—*Discussion on Biological Races and their Significance in Evolution, to be opened by the President.* Other speakers — Dr W B Brierley (Fungi), Dr P Bruce White (Bacteria), Dr T Goodey (Nematodes), Dr W H Thorpe (Insects), Dr W B Turrill (Seed Bearing Plants).

GEOLOGICAL SOCIETY OF LONDON (Annual General Meeting), at 3.—Prof E J Garwood Presidential Address

LONDON SOCIETY (at Royal Society of Arts), at 5 —H. Robertson Modern Architectural Possibilities.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5 —Discussion on Research on Physiological Effects of Baths.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—G G Sherratt and J H Awbery On the Velocity of Sound Waves in a Tube —P S. H Henry The Tube Effect in Sound velocity Measurements —W A Wood Note on the Elimination of the β wave length from the Characteristic Radiation of Iron

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting) (at 32 Welbeck Street), at 5 —Dr H Cohen and Dr P H Whitaker Cinematograph of Ventriculography —Dr R E Roberts (*a*) Lympho-sarcoma involving the Stomach, (*b*) Carcinoma of Lung with Pathological Specimens —Dr J B Mather X Rays of a Case of Idiopathic Myositis Ossifican 1896 and 1930 —Dr H K Graham Hodgson Demonstration of the Technique of Method of Sinus Investigation —C T Holland Radiographs of Unique Conditions

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6 —L Wild Modern Developments in Printing

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6 —Capt A Swan, H Sutton, and W D Douglas An Investigation of Steels for Aircraft Engine Valve Springs —R. G C Batson and J Bradley The Fatigue Strength of Carbon and Alloy Steel Plates as Used for Laminated Springs

SOCIETY OF DYERS AND COLOURISTS (at Manchester Literary and Philosophical Society) at 7 —J S Wilson Solazol Dyestuffs

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7 —Discussion on the Work of M Puyo

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Northern Coke Oven Managers Association) (at Armstrong College Newcastle upon Tyne), at 7 30 —Dr S R Illingworth Some Aspects of the Carbonisation of Coal

ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7 30 —T I Bernard Electrical Methods Ventilation and Air Conditioning

JUNIOR INSTITUTION OF ENGINEERS (at Royal United Services Institution) at 7 30 —A I Grant The Construction of the Variable Density Tunnel for the National Physical Laboratory at Teddington

SHIPLEY TEXTILE SOCIETY (at Shipley Technical School), at 7 30 —A B Shearer Rayon Its Uses in Woven Fabrics

INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers Technical College Bristol) at 7 30 —R T Morgan Thames House

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynaecology Section), at 8. —*Dr A A Osman and Dr H G Close Observations on the Plasma Bicarbonate and the Value of Alkalies in the Treatment of some of the Renal Complications of Pregnancy*

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section) at 8 30 —Discussion on the Future Policy of the Section

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof J B S Haldane Prehistory in the Light of Genetics

GEOLOGISTS ASSOCIATION (North East Lancashire Group) (at Technical College Blackburn).—W L Turner With the Geologists Association in Czechoslovakia (Lecture)

ROCHDALE TEXTILE SOCIETY (at Technical Schools Rochdale) —Gregg Modern Weaving Methods

SATURDAY, FEBRUARY 21

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle upon Tyne) at 2 30 —T V Simpson Old Mining Records and Plans —*Paper open for further discussion* —W H Connell Some Recent Improvements in Surveying Instruments

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —J Stephens On the Reading and Speaking of Verse (2) Difficult Poets

MONDAY, FEBRUARY 23

INSTITUTE OF ACTUARIES at 5 —D Houseman Suggestions on the Legal Aspects of Life Office Practice

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section, London), at 6 45 —D G Sopwith Fatigue in Metals

INSTITUTION OF ELECTRICAL ENGINEERING (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne) at 7 —E T Norris and F W Taylor High Voltage Testing Equipments —B L Goodlet, F S Edwards, and F R. Perry Dielectric Phenomena at High Voltages

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8 —A. Hopewell Smith (*a*) Evidence against the Theory of Metabolic Properties of Human Enamel (*b*) The Head of an Egyptian Mummy

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 —P C Visser The Karakoram and Turkistan Expedition of 1929-30

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School Cambridge), at 8.45 —Prof E V Appleton Wireless Exploration of the Upper Atmosphere

INSTITUTION OF ELECTRICAL ENGINEERING (Western Centre) (at Cardiff). —Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture).

TUESDAY, FEBRUARY 24

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4 30 —A. Wigglesworth The Hard Fibre Industry, with special reference to the British Empire

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5 10 —Prof G T Morgan The High Pressure Plant at the Chemical Research Laboratory, Teddington (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Sir William Bragg Recent Experimental Physics (3) Adhesion (1).

INSTITUTION OF CIVIL ENGINEERS, at 6

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North Western District) (in Geological Department, University, Manchester), at 6.30 —E. Morton The Properties, Selection, and Specification of Sandstones for Use as Kerbstones on Main Thoroughfares.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7—E Fawssett and G E Moore Apparatus and Methods for Accurate Maintenance of Large A C Energy Meters.
INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club, Manchester) at 7—E T Norris and F W Taylor High Voltage Testing Equipments.—B L Goodlet, F S Edwards, and F R Perry Dielectric Phenomena at High Voltages.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group) at 7—E R Davies The Electrical Measurement of Reflection Densities, and a New Photoelectric Reflection Density Meter—M Games Demonstration of the Taxiphote
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent Glasgow), at 7 30—Prof G W O Howe Wireless Telegraphy and the Upper Atmosphere
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent Glasgow) at 7 30.—G J Lugt Supercharging with special reference to Werkspoor Engines
NELSON TEXTILE SOCIETY (at Nelson Technical College), at 7 30—J Yates Manufacturing Efficiency
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30—Gossip Meeting
BRITISH KINEMATOGRAPH SOCIETY (at Film House, Wardour Street) at 7 45
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30—Miss Winifred Lamb Excavations at Thermi in Lesbos
ROYAL AERONAUTICAL SOCIETY (Manchester Branch)—Alfred Herbert Ltd Machine Tools

WEDNESDAY, FEBRUARY 25

SOCIETY OF GLASS TECHNOLOGY (in Applied Science Department, University Sheffield) at 2—The Use of Ammonium Sulphate in Accelerating the Melting of Glass—M Parkin, Prof W E S Turner, and W J A Warren Part I Experimental Small Scale Meltings—The Research Staff of Imperial Chemical Industries, Ltd Part II Experimental Meltings in a Tank Furnace—Dr J T Howarth and Prof W E S Turner The Temperature of Incipient Glass Formation
BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5
GEOLOGICAL SOCIETY OF LONDON, at 5 30—Dr W J Arkell The Upper Great Oolite, Bradford Beds, and Forest Marble of South Oxfordshire, and the Succession of the Gastropod Faunas in the Great Oolite—Dr A Heard and J F Jones A New Plant (*Thallomia*), showing Structure from the Lower Downtonian Rocks of Llandovery, Carmarthenshire
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Teesside Branch—Graduate Section) (at Cleveland Scientific and Technical Institution Middlesbrough), at 7—H McIvor Some Aspects of Mechanical Design
INSTITUTE OF CHEMISTRY (Belfast Section) (at Royal Belfast Academical Institution), at 7 30—J A Matthew Effects of Air Humidity on Cellulose
ROYAL SOCIETY OF ARTS at 8—W G W Mitchell Developments in Television
C.B C SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall Strand), at 8 30—Dr Marie Stopes The Lambeth Resolutions and the Papal Encyclical—Some Contrasts and Comments
BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 1 Wimpole Street), at 8 30 Dr Adrian Stephen On Defining Psycho-analysis

THURSDAY, FEBRUARY 26

ROYAL SOCIETY at 4 30—J C Eccles and Sir Charles Sherrington Studies on the Flexor Reflex, I V—Prof A V Hill and J I Parkinson Heat and Osmotic Change in Muscular Contraction without Lactic Acid Formation
ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5—Surgeon-Comdr S F Dudley *Some Lessons of the Distribution of Infectious Disease in the Royal Navy* (Milroy Lectures) (1).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof J B S Haldane Respiration (2)
INSTITUTION OF MINING AND METALLURGY (at Geological Society) at 5 30
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6—Sir Philip Hartog English Composition for Children of Twelve and Upwards
INSTITUTION OF ELECTRICAL ENGINEERS at 6—Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture).
INSTITUTION OF LOCOMOTIVE ENGINEERS (at Institution of Mechanical Engineers), at 6—R G E Vallantin Compound Locomotives on the Paris Lyons Mediterranean Railway
ROYAL AERONAUTICAL SOCIETY (jointly with British Gliding Association) (at Royal Society of Arts) at 6 30—Capt F Entwistle Meteorological Aspects of Gliding and Soaring
INSTITUTE OF METALS (Birmingham Section) (in Chamber of Commerce, Birmingham), at 7—J L Williams Press Tools for Sheet Metal Working
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7—J M Cross When Scouting Won
EUGENICS SOCIETY (at 20 Grosvenor Gardens, S W 1), at 8.15—Study Circle
ROYAL SOCIETY OF MEDICINE (Urology Section), at 8 30—Dr W R Reynell Sexual Neurosis
ROYAL AERONAUTICAL SOCIETY (Gloucester and Cheltenham Branch).—Anglo-American Oil Co., Ltd Motor Fuels and Modern Methods of Testing
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch)—Major C J Stewart Latest Aircraft Instrument Developments

FRIDAY, FEBRUARY 27

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Electricity Offices, Swansea), at 6.—B Leggett The Medical and Surgical Applications of Electricity
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne), at 6—Dr J Montgomerie Some Notes on Motor Engine Seatings

OIL AND COLOUR CHEMISTS ASSOCIATION (jointly with Institute of the Rubber Industry) (at Milton Hall, Manchester), at 7—G F Thompson and E V Bratby Colours used in the Rubber Industry
BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7 30—J H Strong Some Modern Tendencies in Cotton Manufacturing.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle upon Tyne Section) (at Armstrong College, Newcastle upon Tyne), at 7 30—Dr B Moore Fused Silica in Industry
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College), at 7 30.—A Watson Building Research
JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—W A Tookey Oil Engines for the Maritime Fishing Industry
ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8—Dr P Manson Bahr The Epidemiology of Human Trypanosomiasis
ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Sir Francis Younghusband The Re Birth of India
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas Café, Swansea).—Dr A. J Amor The Pathology of some Industrial Poisons
ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—H Sutton Aircraft Light Alloys

SATURDAY, FEBRUARY 28

MATHEMATICAL ASSOCIATION (at Bedford College), at 3—W J Dobbs The Correlation of Trigonometry and Geometry in Elementary School Mathematics
ROYAL INSTITUTION OF GREAT BRITAIN, at 3—J Stephens A Poetry Recital

PUBLIC LECTURES

SATURDAY, FEBRUARY 21

HORNIMAN MUSEUM (Forest Hill), at 3 30—R W Sloley Water-Clocks and Sun Dials

MONDAY, FEBRUARY 23

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5—T D Young Meat Inspection
KING'S COLLEGE, LONDON, at 5 30—A A Pallis The Exchange of Populations in the Near East (1918–1928)
LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 6—Prof E P Cathcart The National Diet. (Succeeding Lecture on Feb 24

TUESDAY FEBRUARY 24

LONDON SCHOOL OF ECONOMICS at 5—W P Yetts The Cult of Ancestors in Ancient China
UNIVERSITY COLLEGE, LONDON, at 5—Dr H R Ing and Dr Winifred M Wright Physical Properties and Chemical Structure of Drugs in relation to Pharmacological Action (Succeeding Lectures on Feb 26, Mar 3 5 10 and 12)
GRESHAM COLLEGE, at 6—Sir George Newman Physic. (Succeeding Lectures on Feb 25 26 and 27)
ROYAL SANITARY INSTITUTE, at 8—E A Elsby Silicosis Prevention Methods (Chadwick Lecture)

WEDNESDAY, FEBRUARY 25

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5—T D Young Meat Inspection
KING'S COLLEGE LONDON, at 5 30—Dr J A Williamson The Great Age of Discovery The First Circumnavigation
BIRKBECK COLLEGE, at 6—Dr G Shearer The X Ray Microscope
BELFAST MUSEUM AND ART GALLERY, at 8—J F Hunter The Making of Prints from Wood and Linoleum Blocks

THURSDAY, FEBRUARY 26

UNIVERSITY COLLEGE, LONDON, at 5 30—M M Tod The Light thrown by Greek Inscriptions on the Life and Thought of the Ancient World (Succeeding Lectures on Mar 5 and 12)

SATURDAY FEBRUARY 28

HORNIMAN MUSEUM (Forest Hill), at 3 30—A M Hocart Spirit Worshippers of the South Seas

EXHIBITION.

WEDNESDAY, FEBRUARY 25

BIRKBECK COLLEGE, at 8—Exhibition of Recent *Films of Natural History Subjects produced by Visual Education, Ltd*

CONFERENCE.

FEBRUARY 27 AND 28.

ASSOCIATION OF TECHNICAL INSTITUTIONS (at Merchant Taylors Hall E C 3).

Friday, Feb 27, at 11 A M—Lord Eustace Percy Introduction of Major Gen Sir Philip Nash as President Elect
Principal B Mouat Jones Technical Education in Russia

Friday, Feb 27 (*afternoon*), and *Saturday, Feb* 28 (*morning*)—
G H Gater A Descriptive Account of Technical Education in London.
Comyns Carr Industrial Administration
Principal J A. Todd National Certificates in Commerce
J W Ramsbottom Commercial Education in America.

SATURDAY, FEBRUARY 28, 1931.

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Work of the Forestry Commission Progress and Promise

II

IN view of the fact that the first ten years period of the Forestry Commissioners' work was to expire at the end of March 1929 and that a new grant to continue the work would have to be obtained from Parliament, the Commissioners in 1927 discussed with the Government the question of a forest policy for Great Britain under the heads (1) general forest policy, (2) programme for the second decade (being an instalment of policy) which the country was in a position to undertake

Under the question of a general forest policy the Commissioners held that in order to ensure a supply of home grown timber (both softwood and hardwood) adequate for the normal well being of the nation and for safety in time of national emergency, it was necessary to proceed steadily with the afforestation of uncultivated land and the improvement of existing woodlands (almost totally neglected during the first decade) A census of existing woodlands was published by the Commissioners in 1924 An analysis of this most valuable and interesting report showed that the acreage of hardwoods in Great Britain was depreciating, and that the existing woods and the areas which had been felled were in a far from satisfactory position—that, in fact, there was little chance of the private proprietor being able to undertake the work

In the forecast of the present decade's work, it is stated " It had been hoped that the first decade would witness the planting up of arrears of fellings accumulated during the War, and the second (decade) improvement of existing woodlands and a large extension of the area under forest These expectations are very unlikely to be realised " This statement is a most surprising one to find in the report From 1922 onwards it must have been patent to the Commissioners, several of them important landowners, that the heavy taxation and death duties would make it impossible for the private owner to do much to assist the reafforestation of the areas felled during the War Further, the Commissioners presumably had at their disposition official statistics showing the position of the country generally *vis à vis* taxation, the breakup of estates, and so forth All that was needed was a broad forestry administrative experience to point the way to efficient handling of a difficult position

The Commission, however, was tied to a fixed annual coniferous planting programme This next

decade it is again tying itself down in a similar fashion There have already been many complaints throughout the country on the neglect to replant hardwood areas throughout the first decade, an insignificant 7000 acres being the total area dealt with by the Commissioners The latter comment upon the difficulty of dealing with the owners of such areas, touch upon the possibility of asking for powers for compulsory acquisition, etc But the proposed programme definitely shows preoccupation with the coniferous planting programme and a lukewarm attitude towards the existing forest or, better expressed, woodland areas, throughout the country—whether felled during the War, exploited since 1919, or being exploited (as are many oak woods) at the present time Owing to the neglect of the areas felled during the War, they have now been lying disforested for at least twelve years, the forest soil has deteriorated by that period of years, the surface is covered with a heavy weed growth, which will be expensive (and is proving so) to remove The Commission has offered grants to private proprietors to assist in the replanting of such areas, but admit the practical failure of this policy

The ten year forecast furnishes no evidence that the Commissioners have advanced any further towards a solution of this important matter It would appear that they intend to allow the bulk of these areas, possessing a true forest soil, to remain for twenty years unplanted, whilst they purchase elsewhere bare areas of necessarily poorer soil, to grow a coniferous crop, of problematical value at the end of a first rotation Surely the Commissioners realise that the discovery of a solution of this very urgent problem rests at their door At present they do not appear to have got further than the suggested possible course of asking Parliament for compulsory powers to acquire such areas It may be suggested that such a step would not unlikely prove widely unpopular and would do serious damage to the cause of forestry in Britain

That the value of the Commissioners' work since 1919 is recognised by Parliament is evidenced by the grants made for the next decade At the instance of the late Conservative administration, Parliament voted a sum of £5,500,000 into the Forestry Fund, commencing from April 1, 1929 This sum was increased by the succeeding Labour Government to £9,000,000 Forest receipts during the decade are estimated at £2,160,000—giving a total sum for expenditure during the period of £11,160,000.

For forestry operations the estimated cost for the decade is slightly more than £8,000,000 Provision is made for the acquisition of plantable land at a uniform rate of 60,000 acres a year The total planting programme is placed at 353,000 acres, made up of 330,000 acres of afforestation and 23,000 acres of replacements—that is, of replanting existing plantations! It is proposed to continue the system of planting grants, and it is anticipated that between £140,000 and £150,000 may be expended on this work during the decade On the subject of forest workers' holdings, it is laid down that 3000 will be established during the period, at an average cost of approximately £625 each Education and research are each to have allotted £100,000, and special services £20,000

The objects and aims of a forest policy in a country are not necessarily always involved in direct revenue returns in cash The indirect returns, in so far as they are advantageous to the community at large, may have a higher value In Britain it is this latter point of view which must govern the forestry question for some time to come So far as can be judged in these very difficult times, the grants made by Parliament may, through the indirect benefits accruing to the people, be fully justified, and the public may be obtaining a full return for the money expended Future generations will be able to give the true answer But it is believed that the advent of the Commissioners and of their work has already proved of benefit to the community on the countryside The second decade of their activities would be of even greater value to the country as a whole, if the Commissioners would tear up the Acland Report—of admitted value in its day, up to a certain point—and adopt a wider vision and broader principles of forest administration

Physiographic Evolution of Britain.

The Physiographical Evolution of Britain By Dr L J Wills Pp viii + 376 (London Edward Arnold and Co, 1929) 21*s* net

IT is one of the primary aims of stratigraphical geology to integrate into a picture or chart the results of the mapping of rocks or deposits and the palæontology of each noteworthy geological period From the early years of the last century, if no earlier, the pioneers such as Lyell and Trimmer had resorted to this method of portrayal, and the device has been employed by many, perhaps most, of their successors. Some have been content to represent an 'ideal landscape' or a restoration of the assumed distribution of land and water at some specific period of

an area of limited extent, while others, greatly daring, have transgressed narrower limits and attempted to depict regions of continental or even wider extent

In these exercises, more than in most speculations, an author is giving hostages which he may, to his sorrow after, have to redeem, at the same time, the discipline of a preliminary essay upon a map may, and doubtless often does, disclose incompatibility, quite as often as it opens wider vistas

The subject of the present work has been dealt with comprehensively by only two previous writers—Hull in 1883 and Jukes-Browne in successive editions in 1888, 1893, and 1911 These works still have a value, especially the last, for the stratigraphical data they furnish, allowance being made for corrections and results that have accrued from later researches, but Dr Wills's book approaches the subject with a fullness of knowledge to which the earlier writers could make no claim Though in the preface Dr Wills modestly defines his aim as "to fill a certain gap in student literature", there is, we venture to say, no geologist, adept or novice, who will fail to benefit by attentive reading, whether for its copious references to British and foreign literature or for the critical faculty which is brought to bear on the strong and weak points of attractive hypotheses

Part 1 is devoted to the physiographical principles upon which these reconstructions are based, and the subject is illustrated by a large number of well-chosen diagrams, most of which are original, either in their entirety or as the author's amplified interpretation of verbal descriptions of other writers (for example, Fig 9, c Ring-dykes and cone-sheets) A short discussion on the nature of the geological record completes Part 1, our author then plunges very literally *in medias res*—into, not the restoration of Pre-Cambrian physical geographies, but into the Post-Carboniferous systems! This is because "the newer rocks of the geological column on account of their greater simplicity are better fitted than the more ancient systems for a study of the physiographical phenomena of the past"

In these "newer rocks" the author includes the uppermost Coal Measures and Permian rocks, as they and the Trias, in his judgment, originated under more or less similar conditions on the surface of a new continent that he considers to have begun to emerge first in Coal Measure times The present reviewer is disposed to antedate the emergence of this land mass, in view of the many signs of continental conditions seen in the Old Red Sandstone and in the Lower Carboniferous beds throughout the greater part of the British area "It was during the latter part of the Carboniferous period that great earth-movements [the Hercynian] set in, which continued intermittently until its close and for long after"

At the close of the Cretaceous period, a critical condition had again come about which brought with it vast modifications of the European geography, by which the widely extended Chalk Sea was expelled from the greater part of northern Europe, at the same time that the Tethys maintained the character and to some extent the position of the Mediterranean

In our own region great events transpired, earth-movements began which were accompanied by volcanic activity affecting a tract extending from Cornwall to Greenland While these momentous changes were in progress in north-west Europe, others still more impressive were developing farther south The Tethys, which had long sustained the rôle of a great settling vat for the detritus of two continents, now began to yield in a reverse direction, and from a mainly synclinal arrangement became, under compressive stresses, mainly a geanticline nipped between the jaws of the two relatively rigid masses of Hercynian Europe and Africa The effects of this compression are seen in the overriding of the Alpine foreland by successive 'nappes' and the less pronounced reversals of the African slopes These features are illustrated by text-figures 72-84

The Cainozoic system in the Anglo-Parisian 'cuvette', a convenient term introduced by the author to signify "a basin in which sedimentation is going on", is discussed in Chap xvii, and the Quaternary Period under the headings "Glaciated Areas" and "Earth-movement and Climatic Changes in the British Extra-Glacial Area", in Chaps xviii and xix, is a valuable summary of the results of recent work in glacial geology, in which the author has played an important part, and the noteworthy effects of Pleistocene earth-movements in Britain and especially in Scandinavia

The author then reverts to the consideration of the Pre-Cambrian and Palæozoic systems which were held in abeyance until the more accessible record of the Post-Carboniferous series had furnished a readily intelligible illustration of the processes involved Parts 3-8 are therefore devoted to the review of the topics of the Pre-Cambrian

conditions, especially the physiographical processes indicated

"If we limit our studies to the era after a solid crust with continents and oceans had developed with an atmosphere and hydrosphere not greatly differing from those that have obtained in the Cambrian and more recent periods, it seems logical to assume that the processes of change were similar to those of later times, though they may have differed in degree and in the tempo at which they worked"

The Lower Palæozoic systems, embracing Cambrian, Ordovician, and Silurian, are treated as a study of a geosyncline developing in a marine area with insular or submarine volcanoes This geosyncline had for its foreland a continental mass, 'Atlantis', of which the portion now visible consists of the Outer Hebrides and the north-west Highlands, the foredeep comprised Scotland, the Lake District, and northern Ireland, a second deep, at times connected with the foredeep, extended from north Wales to south-east Ireland The sinking of the sea floor persisted in its main features throughout the Lower Palæozoic systems, and the distribution of the types of deposition is explained by reference to the regions of the sea floor

At or near the close of the Silurian period a new restlessness affected the British area, of which some indications had already appeared The geosyncline began to give way, just as in Tertiary times we have seen that of southern Europe did It was in fact nipped, as the type was later, between two massive jaws, of which that on the south-east is obscure The culmination of this movement is placed by the author in the time immediately preceding the Dittonian, or upper part of the Lower Old Red Sandstone, it affected not only the north-west and west of the British Isles but also extended in one direction through the length of Scandinavia, where its course is approximately north-east with overthrusting to the north west In its extension through Scotland and Ireland the alignment was changing to a more east to west direction in the south of Ireland, where it encounters the Atlantic Beyond the two apparent termini these Caledonides may with much probability be traced on the north in a majestic curve through Spitsbergen into northern Greenland In the opposite direction, in the Acadian chain of North America, comparable structures have long been known, the connexion being by an assumed syncline crossing the present floor of the North Atlantic, with a branch passing up Davis Strait and Baffin Bay

A transgressive series, marine in the south and continental in the north of Britain, brought in a new continental condition indicated by the Old Red Sandstone and Carboniferous series, to the description of which the author devotes some fifty pages The conditions of deposition of the Lower Carboniferous appear to have been more fully marine in the south and deltaic growths in the north, with occasional periods of balance between deposition and subsidence, leading to the formation of swampy flats upon which peat-beds to form coal seams were accumulated The clearer waters of the Anglo-Welsh area gave origin to great beds of Carboniferous limestone, the deposition of which was, however, controlled by faulting movements, of which the Craven faults marking off the 'Rigid Block' of Prof Marr are examples The researches of Garwood and his school have enabled the mapping of the components of the limestones and of the Yoredale facies to be traced over large areas through the British area

This phase was brought to a close by the invasion from the north of the great series of coarse grits of mainly deltaic origin with intercalations of marine shales characterised by a succession of goniatites, forms by the aid of which the baffling complication of sandstone beds has been unravelled A very full discussion of the conditions attending the deposition of the Coal Measures, perhaps the most complete 'restoration' which is possible for any British formation, and the formation and constitution of coal seams brings this section to a close

A concluding chapter is devoted to the description of the succession of volcanic rocks in the British series

It remains to say that the book is very fully indexed P F K

The Problem of Chemical Affinity

Le problème de l'affinité chimique et l'atomistique étude du rapprochement actuel de la physique et de la chimie Par Prof Charles Brunold Pp v + 118 (Paris Masson et Cie, 1930) 20 francs

THE author of this very interesting essay has dealt with the theme of chemical affinity in its relation to physical theories from the early period to the present day His treatment is historical and critical, and the main conclusion which he reaches is that the problems of chemical combination grouped together under the concept

'affinity' have always proved, and are for some time likely to prove, much too complex and specific to allow of any explanation by prevailing physical theory which will prove at all satisfying to the chemist He begins his historical account by the statement that "the notion of affinity was introduced into science in 1733 by Boerhaave", whereas it is well known that the name was used by Albertus Magnus, and that very detailed investigations on elective affinity were published by Mayow in 1674, based on earlier quite definite and clearly expressed opinions of Boyle These ideas, carried further by Stahl (whose results seem to be incorporated, without acknowledgment, by Newton in his "Opticks"), were summarised in the Affinity Tables of Bergman The first attempt to explain the results on the prevailing physical theory made use of mechanical conceptions, since mechanics was then the senior branch of theoretical physics Newtonian attractions were introduced, and when the researches of Berthollet had removed the foundation of Bergman's theory, their author could still make appeal to the mechanical attractions between the particles to account for the action of mass

With Davy and Berzelius another epoch began The study of electricity had become of predominating interest in physics, and the electrochemical theory sought to subordinate all chemical theories to the laws of electrostatics This view, in turn, soon proved insufficient, and the study of carbon compounds and substitution turned the thoughts of chemists away from the views of Berzelius The latter, however, had much in them which has reappeared in modern theory, especially in the views of Kossel, and as M Brunold says, the explanations which may serve for the compounds of one single element, carbon, need not necessarily apply to the other ninety-one It has gradually become clear that there are, in fact, two different types of valency at least, 'polar' in ionic salts and 'non-polar' in compounds such as those of carbon The ordinary valency formulæ, which may express well enough the reactions of carbon compounds, fail completely in the chemistry of other elements The theory of Werner has filled an important place in this field, and it would have been desirable for M Brunold to have devoted a little more space to its explanation With the advent of the theory of energy, a relation between affinity and heat of reaction was introduced, but this in turn proved abortive

After the new advances in physics leading to the isolation of the electron and the study of the structure of the atom, another attempt to explain the phenomena of chemical combination could be made The earlier atom models are considered one by one, and the reasons for their abandonment (after they had promised to provide explanations of valency) are explained In the closing pages of the book it is made clear that the latest atom models are in turn fading from the screen, and that "the mechanics of Bohr seems to-day out-of date" In this section, the important part played by the Periodic Table, an achievement of pure chemistry, is properly emphasised "Every time that the theories or methods of physics have, in the study of chemical problems, attacked a case of some slight complexity, they have been compelled to make an appeal to the results of chemistry, that is to say, to renounce at least provisionally a development according to their own proper means"

It will be seen that the opinions of the author, all of which are most carefully reinforced by relevant chemical facts, are not without a certain vigour, and the book is one which both chemists and physicists can read with interest and profit The molecule with which the chemist operates is to a large extent static, and whatever relation it may have to prevailing physical theory, the 'octet' is something which, according to M Brunold, 'works'

Philistine Cities

(1) *Gerar* By Sir Flinders Petrie Pp vii + 34 + 72 plates 50*s*

(2) *Beth-Pelet I (Tell Fara)* By Sir Flinders Petrie, with a Chapter by Olga Tufnell Pp vii + 26 + 72 plates 50*s*

(3) *Corpus of Dated Palestinian Pottery* By J Garrow Duncan Including Pottery of Gerar and Beth Pelet dated and arranged by Sir Flinders Petrie, and Beads of Beth-Pelet dated and arranged by J L Starkey Pp 21 + 83 plates 30*s*

(London British School of Archæology in Egypt, Bernard Quaritch, Ltd, 1928–1930)

THE British School of Archæology in Egypt has widened the scope of its activities, and since 1926 has conducted excavations in the coast plain of south Palestine For this change there was the excellent reason that the only period of Egyptian history of which even the outlines are obscure is that of the Hyksos conquest, and for this it was in this quarter, whence those conquerors apparently came, that clues were most likely to be found

(1) In 1926 and 1927 the selected site was Tell

Gemmeh, identified with the Biblical Gerar, eight miles south of Gaza and from the coast, a natural hill of fifty feet, covered by another fifty feet of debris, scarped by the Wady Ghuzzeh and deeply eroded by wind and rain, so that only a small area of its original platform-top remains Six successive periods of building were uncovered, within a depth of thirty feet, each ignoring its predecessor, so that there was good evidence for distinguishing the contents of each They were assignable, respectively, the latest to the Persian conquerors in the sixth century B C , the earliest to the Egyptian protectorate of Thothmes III in the fifteenth Between these there were reoccupations by Rameses III about 1194 B C , by Shishak about 930 B C , by the Jewish Amaziah about 810 B C , and by Psammetichus I about 660 B C

Among architectural remains, the great military granaries are notable among the small objects, an interesting series of safety pins, of local workmanship, and surprisingly early date, according to the excavators , the copious strings of amulets and beads, of the centuries from 1200 to 950 B C , the evidence not only for iron smelting but also for the tempering of swords, about 870 B C , and the rudely sketched linear designs on limestone incense-burners resembling those of iron age Cyprus The pottery, especially in the 'Philistine' period, is influenced, as at Lachish and Askalon, by Minoan pot-painting from oversea The numerous weights give a clue to successive commercial systems which have prevailed along the great corridor between Asia and Egypt, in which Gerar lay

(2) In 1928 work was begun at Tell Fara, a large site, rather farther inland, and deeply eroded by the Wady Ghuzzeh so that its structure was revealed, with nearly fifty feet of ruins on a natural hill a hundred feet high Practical difficulties were greater here than at Gerar, the nearest water, for example, being eleven miles off The position and contents of this site identify it, as its name also suggests, with Beth Pelet, the home of the Pelethites, King David's royal bodyguard Besides the contents of the fort and its houses, the cemeteries yielded instructive material The Hyksos period, with characteristic un-Egyptian pottery, and scarabs imitated from a series of Egyptian models, runs from the days of the XIIth Dynasty to the XVth, which represents the Hyksos conquerors of Egypt, as known from graves at Yehudiyeh and it is claimed that the sequence of scarab designs at Tell Fara shows that the XIIIth and the XVIth Dynasties were parallel, and began together at the close of the XIIth.

The Egyptian protectorate of the XVIII-XIXth Dynasties is a period of conflicting influences Egyptian from the south, and Minoan from oversea Debased Minoan decorations are here dated surprisingly early, and oddly identified The scarabs seem to be still the basis of chronological sequence A steel dagger (Pl xxi 90) about 1370 B C is noteworthy both for form and for material Tutankhamen's dagger is of the same generation Flange hilted daggers of bronze are also early of their kind , and there are some interesting forms among the ear rings A terra-cotta horseman (TM 379) is oddly described as "Scythian" though dated "to the age of David and Solomon"

A notable group of tombs is described as "Solomonic" They are stone-lined and roofed with stone-slabs, and contained ornaments of gold, with occasional electrum and silver and fine cornelian beads The ivory gaming board, 188, is described as "unique" on p 12, but as "a well-known form" on p 109 Among the later tombs, the Egyptian lotus ornament on a vase (17 K7 in text, cf 17 P5 in Pl xxxix) is notable, if it be so early as is said , and the calendar reckoner (Pl xl 481) very curious On the small face-amulets (xl 493-5) the feather head-dress of the 'sea-raiders' of Ramessid times reappears Far the finest art works from this site are the silver bowl and bronze ladles, and the jointed bedstead of iron, bronze, and wood, from a fine tomb of about 850 B C

The fort itself shows the same characteristic glacis defences as Hyksos sites at Yehudiyeh and Heliopolis Its inner arrangements have naturally been much remodelled under Egyptian, Philistine, and Israelite rule , and the site was heavily refortified during Shishak's occupation of Palestine in the tenth century

(3) Mr J Garrow Duncan's "Corpus of Dated Palestinian Pottery" includes the new material from Gerar and Beth-Pelet, and also from the American excavations at Bethshan. The arrangement is by shapes, and consequently fabrics are often mixed, as well as periods and sites , but for ready reference the shapes are most easily recognised , and a convenient notation gives a clue to date and provenance Decorative designs are also analysed into their component motives, again irrespective of style or fabric , which is much less convenient or instructive At the end is a similarly constructed key to Palestinian beads There are some useful notes on the general discrepancies in dating among earlier excavators in Palestine, and on the uselessness of certain well-known pieces of work, through neglect of obvious precautions.

Our Bookshelf.

Leçons de géométrie projective Par Prof Federigo Enriques Traduit de la quatrième édition italienne par Prof P Labérenne Pp iv + 430 (Paris · Gauthier-Villars et Cie, 1930) 60 francs

THE present French translation from the fourth edition of these lessons on projective geometry by the eminent Italian mathematician-philosopher to a certain extent meets a long-felt want Perhaps the most striking feature of the book is the remarkably clear and consistent way in which the subject is developed from its logical foundations solely by means of graphical methods, based upon five purely geometrical postulates together with a sixth which is the geometrical equivalent of Dedekind's continuity theorem Although so much stress is laid upon projective constructions, the relations between projective and metrical geometry are expounded in the text whenever occasion arises, whilst the connexions with group theory and algebraic geometry are touched upon in several appendices

As regards the detailed arrangement of the book, it is sufficient to state that the first five chapters deal with definitions, fundamental propositions and preliminary theorems, the law of duality, the postulate of continuity, and Staudt's theorem Then follow chapters on projectivities and involutions between forms of the first and second ranks, with applications to conics, their projective and focal properties, and to cones, ruled quadrics, and twisted cubics A chapter on projectivities between forms of the third rank completes the work The perusal of this book is sure to afford great pleasure to all interested in the development of projective geometry

Testing Radio Sets By J H Reyner Pp vii + 178 + 8 plates (London Chapman and Hall Ltd , 1930) 10s 6d net

THIS book gives a series of suggestions for the tracing of faults in the simpler types of receiving apparatus It is not likely to be of assistance to qualified radio engineers , but, as there are few books on the subject, it will be useful to amateurs with a limited amount of technical knowledge The author's discussion of the effects produced in a high frequency choke coil is correct, provided that it is not in parallel or virtually in parallel with other components of the receiver. The conclusion he draws (p 59), that it acts like a small capacitance which has the property of allowing direct current to pass through it, is too vague The advisability of discharging the condensers in an eliminator or mains-driven receiver is pointed out The way he suggests, however, of placing the metal part of a screwdriver across the terminals of the reservoir condenser, is open to criticism, for such violent discharges have been known to damage the condenser. It would be better to discharge it through a resistance

The part of the book dealing with 'laboratory testing' seems to be a brief outline of the measurements that can be made in the author's own laboratory In places it would be well if the author had been more explicit On p 23, for example, we read, "we will assume that this circuit functions, but in a poor manner" There are many different 'poor manners' in which a circuit can function The chapter on American test data will be useful

Growing Tree and Small Fruits By H B Knapp and E C Auchter (The Wiley Farm Series) Pp xiii + 510 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 15s net

THE needs of practical fruit-growers and students are here specially catered for by providing them with a text book which can also be used as a reference volume for points of detail To this end, an attempt has been made to render the various sections of the book complete and independent, in order that information unnecessary for the individual may be passed over without fear of losing other points germane to the question in hand Each of the main fruits is dealt with separately, from harvest to harvest, marketing operations being included , and in addition special chapters are devoted to wider problems of more general application, including, amongst others, orchard establishment, pruning, propagation, thinning fruit, and the control of diseases and pests Here again, where necessary, the application of the problem to particular fruits is indicated individually and adequately indexed The scientific names of some species of the common fruits are appended , and hints for practical work, given at the end of each chapter, increase the usefulness of the volume for students' class work

The Journal of the Institute of Metals Edited by G Shaw Scott Vol 43 Pp xii + 838 + 40 plates (London Institute of Metals, 1930) 31s 6d net

STUDIES of the influence of gases on cast metals occupy an important place in this volume Both hydrogen and sulphur dioxide cause unsoundness in copper and bronze, and removal of them by means of nitrogen or some other insoluble gas, or by melting under reduced pressure, has been found to improve the quality of the ingots or castings The four papers on this subject all owe their origin to the Non-Ferrous Metals Research Association, whilst the same body is responsible for the work by R Genders on the increased resistance to corrosion produced by the addition of small quantities of aluminium to brass, this being one of a number of instances now known of the protection of an alloy by an external film consisting mainly of aluminium oxide A communication by C F Elam is interesting as recording the progress of solid diffusion of zinc through brass by the application of X-ray methods A lengthy paper by T A Rickard on the early use of the metals led to a discussion in which archæologists as well as metallurgists took part The scope of the Institute of Metals is wide, and its journal is an invaluable source of information concerning the progress of metallurgy

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Meaning of Existence.

PROF. MUIRHEAD'S illuminating letter in NATURE of Feb. 7, p. 197, raises innumerable questions which I am not qualified to discuss with him, but I should like to add a comment on the narrower scientific aspect of the problem.

Here are two quotations, forty years apart, from eminent men of science:

(1) Lord Kelvin in 1889:—"[The ether] is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether."

(2) Sir Arthur Eddington in 1929:—"Among leading scientists of to-day, I think about half assert that the ether exists, and the other half deny its existence; but as a matter of fact both parties mean exactly the same thing and are divided only by words."

We are in the paradoxical position that two scientific workers of to-day who say "Yes" and "No" both mean precisely the same thing, while two scientific workers forty years apart, who both say "Yes", mean diametrically opposite things. The key to the paradox is, I think, to be found in Prof. Muirhead's words: "before there can be any talk of existence you must define the world within which it is affirmed—what the logicians call 'the universe of discourse'."

The physicist of forty years ago did not suspect the need for any such definition. Surrounding and conditioning our world of consciousness, he saw a vast independent universe of concrete machinery, which he unthinkingly and unconsciously accepted as his 'universe of discourse'. On the other hand, the scientific worker of to-day finds his 'universe of discourse' in the phenomenal universe as apprehended by his brain. The crux of the matter seems to me to be that this does not—like the old ocean of machinery—provide a single, clearly defined 'universe of discourse'. It rather gives us a collection of universes of discourse, some greatly overlapping but some almost independent, some objective but some largely subjective.

First there is the universe of the astronomical observatory and the physical laboratory, which is "continuous with the world of the felt, waking body", experience showing that this is identical for all of us, at any rate outside lunatic asylums. I think science now compels us to give an unqualified denial to the existence of an ether in this universe of discourse.

Then there is the mathematical universe of discourse, which deals only with such phenomena as can be reduced to 'pointer readings'. Those who want an ether in this universe may have it, just as they may have Cartesian or polar co-ordinates if they want them; but it will be a mathematical ether, not 'continuous with the world of the felt, waking body'.

Finally, there is the universe of discourse provided by that world which, in Prof. Muirhead's words, "resolution into mathematical symbols or 'pointer-readings' fails to make intelligible", including—if one must use the word—the world of 'values'. Although I am in almost complete agreement with Prof. Muirhead, I differ from him in thinking that an ether can have any existence in this world, or even any meaning, mainly, I suppose, because 'values' do not enter into clearly defined relations with time and space. In brief, I would contend that in the physical world an ether is non-existent; in the mathematical world it comes into being at the beck and call of the mathematician; in the world of 'values' it is meaningless.

J. H. JEANS.

Validity of the Genus *Sinanthropus*.

PROF. MARCELLIN BOULE, Director of the Museum National d'Histoire Naturelle in Paris, has written to me with reference to my Henderson Lecture, "The Significance of the Peking Man", extracts from which appeared in NATURE of Feb. 7 (p. 202), to direct my attention to the fact that long before Dr. Weinert expressed doubt as to whether the Peking man should be excluded from the genus *Pithecanthropus* he had made the same protest. To quote his own words: "Je crois être le premier à avoir rapproché intimement le *Sinanthropus* du *Pithécanthrope*. Voyez *L'Anthropologie*, t. 39 (1929), pp. 455-460."

In my Edinburgh lecture I purposely refrained from mentioning Prof. Boule's name, because his opinion was expressed before the fuller information was available, which seems to me to be fatal to his view. Dr. Weinert's book was written, however, after this evidence was issued. Hence it was not unfair to quote him as the supporter of an opinion which I think is mistaken.

The question of priority is not a matter of any particular consequence. As a matter of fact, at a meeting of a students' society in this College (the University College and Hospital Anthropological Society), before either Prof. Boule or Dr. Weinert raised this question, Dr. H. S. Harrison, of the Horniman Museum, started a discussion by suggesting that the fossil from China was a representative of the genus *Pithecanthropus*.

I should like to point out that in his preliminary announcement of the discovery of the skull (on Dec. 2, 1929) Prof. Davidson Black directed attention to its resemblance to the calvaria of *Pithecanthropus* but gave cogent reasons for according it generic distinction. The profound contrast of a fossilised human tooth from China to those of *Pithecanthropus* was pointed out so long ago as 1903 by Prof. Max Schlosser (*Abhandl. d. k. Bayerisch. Akademie Wissensch.*, Math. Phys. Klasse, Bd. 22, p. 20), and in his great monograph (*Palæontologia Sinica*, 1927) on the tooth which served as the type of the genus *Sinanthropus*, Prof. Davidson Black still further emphasised the contrast and justified his action in creating the genus, the validity of which is admitted by every palæontologist who has seen the actual specimens. As I have emphasised in my Henderson Lecture, the form of the brain case, the morphology of the individual bones, and even the architecture of the diploe, all corroborate the inferences drawn from the teeth that *Sinanthropus* is a distinct genus. Although the fossil from China definitely approaches more nearly to *Pithecanthropus* than to any other genus, the monograph which Prof. Davidson Black has written for immediate publication in *Palæontologia Sinica* (ser. D, vol. 7, fasc. 2) provides the full evidence, comparative data, and the statistical justification for its generic independence.

While the question of determining what criteria are necessary to justify the creation of a separate genus is one that does not admit of an exact answer, I do not think that anyone who has compared, as I have recently done, the actual Chinese fossils with those of other men and apes and the casts of fossil human skulls, would fail to realise that the inclusion

of the Peking man in the genus *Pithecanthropus* would introduce an undesirable element of confusion into this difficult field of interpretation

G ELLIOT SMITH

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Feb 9

Raman Lines in X-Ray Spectra

A VERY interesting and significant phenomenon has been described by Ray [1] and by Majumdar,[2] in which it is shown that a quantum of the radiation energy, say of the wave length comprising the copper K_α lines, may, on passing through carbon or aluminium, be diminished by an amount sufficient for the ejection of a K electron from a carbon or an aluminium atom, and then pass on in the same or very nearly the same direction with a reduced energy $h\nu'$, and consequently a greater wave length

$$\nu' = \nu_{a1} - \nu_k,$$

where ν_{a1} is the frequency of the copper K_{a1} line, and $h\nu_k$ is the energy required to remove a K electron from the carbon atom

In the communications mentioned above, photographs are shown in which lines may very plainly be seen corresponding to this part absorption in carbon, nitrogen, and oxygen It was stated that carbon in the form of soot was used, but nothing was said as to how thick the absorbing layer was, nor regarding the manner of employing nitrogen and oxygen Since, in every case reported, a line due to at least one of these gases appeared along with the line due to carbon, it is evident that the three substances were all used at the same time In discussing the work of Ray, Bhargava [3] says the X rays passed through air, and Ray, in his later paper,[4] makes no comment on this point, but mentions that a Siegbahn vacuum spectrograph was used

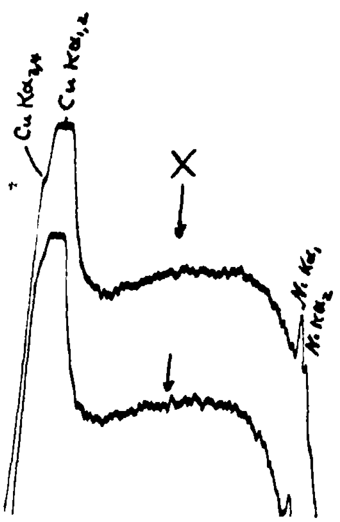

FIG 1 —Photometric curves of spectrum taken through a carbon absorbing screen

The question of such absorption is so important that I have also attempted to obtain these lines photographically, but have been quite unable to find them In my work a copper target was used, first with a tungsten filament, and later with one of nichrome, so that the layer of tungsten, which sputters on the target from a tungsten filament, might not be present, thus giving greater intensity to the copper radiation, and also avoiding the stronger continuous spectrum from tungsten

The carbon, first in the form of graphite, and later in the form of so-called amorphous carbon, was placed in the X ray tube immediately before the slit Afterward it was also used just against the slit on the other side, facing the crystal The optimum thickness of the carbon screen for manifesting the effect sought should be $\frac{1}{\mu}$, where μ is the linear coefficient of absorption of the given wave length for carbon Screens were used of varying thickness, some thicker than the above value, and some thinner

The spectrograph had a radius of about 14 cm It was not evacuated The calcite crystal was rotated uniformly over nearly one degree, by means of clockwork In some trials it was also turned by hand about every ten minutes, and in other cases it was left stationary during the entire exposure The time of exposure varied from five to nineteen hours The tube current was from 10 to 25 milliamperes, and the voltage, while not accurately measured, was perhaps from 15 kilovolts for some exposures to 35 for others

In cases where the crystal was allowed to stand, or was moved irregularly, certain lines, often quite sharp, appear, especially near the limit of the continuous radiation If the crystal is moved, these lines also move and appear in another place It is a common experience that such lines may be found with almost any crystal if it is not properly rotated In my best photographs, with uniform rotation of the crystal, it is quite impossible to see any line in the place required for the partial absorption in carbon, and as found by Ray Unfortunately, he does not state how the crystal was rotated in his experiments

Ray has estimated the relative intensity of these Raman lines to be about $\frac{1}{100}$ or $\frac{1}{500}$ that of the copper K_α lines Now Richtmyer and Taylor [5] give the intensity of the satellites $K_{a3,4}$ of copper as about $\frac{1}{100}$ the intensity of copper K_{a1} On my plates the line copper $K_{a3,4}$ is strong, hence I conclude that the exposures are sufficiently long to produce the lines sought, if they were present in anywhere near the above intensity

Fig 1 shows a photometer record of one of the plates obtained The two curves were taken at different levels across the spectrum to show that the irregularities are due to the grain in the plate X marks the point in the spectrum at which the displaced line due to carbon should appear The $K_{a3,4}$ line can be seen plainly

GEO A LINDSAY.

Natuurkundig Laboratorium,
Groningen, Holland,
Jan 17

[1] NATURE, 125, 746, 856 126, 390 and *Zeits fur Phys*, 66, 261, 1930
[2] NATURE 127 92 1931
[3] NATURE 126, 398 1930
[4] *Zeits fur Phys*, loc cit
[5] *Phys Rev*, 36, 1044, 1930

Modification of Quanta by Photo-Ionisation

IN continuation of our previous communication of experiments on the phenomenon described by Dr B B Ray,* we wish to report that we allowed silver $K\alpha$ radiation to pass through nickel foil 0 06 mm in thickness, and photographed the spectrum of the emergent ray We found, after an exposure of 150 mA hours, a modified band with a sharp edge at ν/R = 1019 7, fading towards the long wave length side, but with no trace of blackening on the short wave length side The difference between ν/R of silver $K\alpha_1$ and that of the sharp edge obtained is ν/R – 612 9, while, according to Siegbahn, ν_k/R of nickel (K absorption edge of nickel) is 612 The experiment, therefore, clearly supports the view that the quantum on its passage through the atom may impart to the electron in the K shell all energies from $h\nu_k$ to $h\nu_0$ and become modified to quanta of any frequency less than $\nu_0 - \nu_k$

SALIGRAM BHARGAVA
J B MUKERJIE

Physical Laboratory,
University of Allahabad,
Jan 24

* [NATURE, Feb 21, p 273 —Ed NATURE]

Raman Spectra of Organic Sulphides

IT is more or less generally accepted that the various Raman frequencies of a molecule correspond to the oscillations of its component parts with respect to one another, each frequency being associated with one particular mode of oscillation This conception of the origin of the frequencies is very fruitful in correlating the Raman spectra of molecules with their structure One particular aspect of the application of this idea has attracted considerable attention during recent years, namely, the assigning of certain frequencies to each type of chemical bond and tracing their variation from compound to compound We have made a detailed study of the Raman spectra of a number of organic sulphides and we give below the results obtained in two typical cases, ethyl sulphide and allyl sulphide, one representing the saturated and the other the unsaturated compound

The Raman spectrum of ethyl sulphide is very simple, while that of allyl sulphide is rich in lines and also presents a continuous background A comparison of the scattered spectrum of ethyl sulphide with that of ethyl ether shows a general agreement so far as the long shifts are concerned The effect of the substitution of the heavier sulphur atom in the place of oxygen is to diminish the frequency shift, the changes in the shift getting smaller as the value of the shift increases

	Wave numbers per cm
Ethyl Sulphide $(C_2H_5)_2S$	652, 1061, 1282, 1439, and 2923
Allyl Sulphide $(C_3H_5)_2S$	410, 588, 741, 917, 1011, 1101, 1210, 1291, 1312, 1420 1534, 1636, 3007, and 3088

Thus, corresponding to the sulphide shifts 1061, 1439, and 2923, we have the other shifts 1082, 1457, and 2936

The Raman spectrum of the sulphide resembles that of the corresponding alcohol in the region of the longer frequency shifts, while conspicuous changes are observable in the region of the shorter shifts The frequency 652 in ethyl sulphide, which is presumably due to the C–S bond, is also the prominent frequency in carbon disulphide, the nature of the bond apparently having no effect on the oscillation frequency This frequency is absent in allyl sulphide Similarly, the prominent frequency 741 in allyl sulphide (which is also present in allyl thiocyanide) is absent in ethyl sulphide It seems that the frequency 741 is characteristic of the unsaturated sulphides, and the frequency 652 of the saturated sulphides

V N THATTE
A S GANESAN

College of Science, Nagpur,
Jan 12

The General Factor in Spearman's Theory of Intelligence

I HAVE recently undertaken an investigation of the theory of 'factors' from a mathematical point of view This work is now complete and I hope to publish it shortly in full The conclusions in brief are that, with certain reservations, the theorems relied on by psychologists are correct. They are, further, independent of the theory of probability that is to say, no questions of distribution arise until we come to applications

It is surprising that this comparatively simple work has not been done before The reason seems to be that it has always been approached from the probability point of view, whereby difficult but irrelevant considerations have been introduced. It may, however, be noted that Yule in his classical paper on partial correlation (*Proc Roy Soc*, 1907) proved his results independently of distribution, and that Spearman (*Proc Roy Soc*, 1922) stated that the theorem proved by Garnett for error distributions (*Proc Roy. Soc*, 1919) had a similar generality This is the subject of Prof Piaggio's letter in NATURE of Jan 10 Another reason why mathematicians have as a rule failed to interest themselves in the theory lies in the special meanings assigned to common mathematical terms by statisticians and psychologists independent for orthogonal, factor for component, array for section, etc, and the extension of the term 'error' to cover all components not under consideration

The subject matter of statistical science is sets of measures of variates, that is, sequences of numbers, which for theoretical purposes may be reduced to standard deviation measure These sequences can, like real functions of which they are a reduced case, be subjected to orthogonal partition and can be developed in series of sequences N being the number of elements in each sequence, all sub-sets of N-1 independent sequences, orthogonal or not, are 'complete', and all sequences of the whole set can be developed linearly in terms of any complete sub set The possibilities for the expression of a sequence in terms of 'factors' are therefore unlimited, a fact upon which Godfrey Thomson has insisted from a rather different point of view The theory can at this point be linked with that of linear substitutions or with that of unit vectors in multispace, but for the object in view there does not appear to be any advantage in doing so

I have obtained the conditions for the existence of a sequence having given correlation coefficients with a given sub set, and for the existence of a sub-set having a given array (mathematical sense) of correlation coefficients, together with the method of obtaining such a sequence and such a sub set In view of its great interest, I have also made a study of Spearman's two factor form following the above methods This form may be said to have the general validity claimed for it, it may be remarked, however, that there is another class of cases, besides those with negative correlations mentioned by Garnett, in which 'equiproportionality' (Dodd) does not imply the form I do not entirely agree with Prof Piaggio's statement that the arbitrary sequence i can be made as small as we please, this depends on the divergence of a certain series, which is not bound to diverge

When we come to application, distribution is all important An orthogonal partition of a sequence is of course not invariant for monotonic transformations, so that a partition such as Spearman's two-factor form is entirely dependent on the distributions adopted In statistical measurements as a rule, and in psychological measurements always, there is no measuring rod, so that distributions are at our mercy, and it is usual to make them fit some standard such as the curve of errors and to insist on the linearity of the regressions It is therefore on this standard distribution that the two-factor theory must rest, and not on the general method of partition. Karl Pearson has criticised Spearman's 'hierarchy' of correlation coefficients from the point of view of closeness of fit A mathematician with a less severe statistical morality will, however, have no objection to Prof Spearman making his fit perfect by small monotonic transformations or linear substitutions.

Orthogonal partition often connotes physical reality, as, for example, with harmonics in sound, but it must be remembered that in such cases the partition is completely specified by physical laws and conditions,

expressed as differential equations and boundary conditions Orthogonal partitions not so specified exist in infinite variety and have no physical significance. The question is, when do orthogonal partitions of sequences have a physical meaning ? Spearman has discovered a remarkable method for the analysis of statistical data , the greatest caution is necessary in interpretation H B HEYWOOD

Talking Beacon of the Cumbrae Lighthouse

IN NATURE of Jan 24, p 138, a statement appears regarding the talking beacon of the Cumbrae Lighthouse which calls for some comment The use of synchronous signals in air, water, and ether for navigational purposes dates, so far as I know, from experiments carried out near New York in 1911 These led to the installation of such signals on the Fire Island Lightship, where submarine bell and wireless dots were used to enable an approaching vessel to determine its distance from the lightship

In complete ignorance of this pioneer work, I contributed several papers to the Royal Society between 1915 and 1918 on synchronous signalling in navigation, and more especially on the prevention of collision at sea Two of these were reprinted on the North Atlantic Chart of the Hydrographic Office of the U S A for June 1917 A discussion of the subject appears in a book (London Fisher Unwin) in 1916 and finally, a general account up to date appears in the *Phil Mag* of July 1918

In the last mentioned paper (p 18) the de Forrest system, as used at Point Judith at the western approach to Narragansett Bay, is referred to ' A phonograph [= gramophone] speaks the words It cries the name of the lighthouse or lightship into the transmitter The system is entirely automatic The voice, translated into ether waves, reaches the antenna on the ship and is there re translated to the spoken words by a detector and telephone After every third repetition of the name of the station a much feebler voice speaks the warning ' You are getting closer , keep off ' "

Much of this is identical with the system installed at the Cumbrae Lighthouse , but Messrs Stevenson replace the feebler etherial message by the now well known method of synchronous signalling , that is to say, by signals issued simultaneously in different media This method is available in two forms signals travelling in air and in ether or signals travelling in water and ether The latter is far more trustworthy, but is only of use to such vessels as are fitted with receptors for submarine sounds

That risks attend the use of synchronous signals in which the atmosphere is one of the media is well known This risk arises out of the fact that ' silent areas ' under certain weather conditions may exist around the vessel—especially in fogs, *but also in quite clear weather* This risk is specially referred to in every " Sailing Directions " issued by the Admiralty " Sound is conveyed in a very capricious way through the atmosphere Apart from wind, large areas of silence have been found in different directions and at different distances from the origin of a sound, even in clear weather Therefore too much confidence should not be felt in hearing a fog-signal Taken together these facts should induce the utmost caution in closing the land in fogs The lead is generally the only safe guide " In my yachting days I have more than once experienced such conditions ; and, on one occasion, lasting for more than eight hours This was off the western coast of Ireland, between Loop Head and Tearaght Island

While it is very certain that the use of sound transmitted in air, as taking part in the estimation of distance, will in many cases prove available, it is questionable if this modification of the de Forrest system is wise The latter acts as ' a still small voice ' which is only heard when there is real danger and of course two or more observers may listen in Its directions reach the mariner as a spoken warning not to be misunderstood The voice cries to him again and again " Keep off—you are getting closer ", " Keep off—you are getting closer "

The addition of Dr de Forrest's warning voice to the name call of the gramophone at Cumbrae would be easy, and the whole system would become more generally reliable

I would like to add an expression of my complete concurrence with all that is said in the article on the Cumbrae Lighthouse beacon in the *Times* of Jan 13 regarding the noble work for coastal navigation accomplished by the late Robert Stevenson and his successors, Messrs C A and D A Stevenson

J JOLY
(Commissioner of Irish Lights)

Trinity College, Dublin,
Feb 2

Effect of Desiccation on the Bed-bug (*Cimex lectularius*)

IT is well known that, during starvation, the bed bug, like many other insects, swallows considerable quantities of air, which serve to maintain the body volume in place of the food and tissues that are consumed I have recently observed that if the first stage larvæ of the bed bug are kept for several weeks in a moderately dry atmosphere (for example, 50

FIG 1 FIG 2

per cent relative humidity at 23° C), as the circulating fluids become less, the gut, containing bubbles of air, becomes herniated into the bases of the limbs, and may extend far down the femora (Fig 1)

If such insects are exposed now in a saturated atmosphere, although most of them die in a few days, others recover , moisture is taken in, and the bubbles of air disappear from the limbs On the other hand, if they are retained in the dry atmosphere, the gut wall eventually breaks, and bubbles of air are set free into the body cavity (Fig 2) The larva in this state is often still capable of sucking blood, and if given a moderate meal, both the bubbles in the gut and the free bubbles in the limbs disappear into solution During this process a certain amount of blood usually escapes into the body cavity, and the red corpuscles can be seen circulating in the blood of the insect I have had larvæ in which such corpuscles have continued to circulate, apparently unchanged, for three weeks—long after the blood in the gut had been completely digested

Apart from the curious circumstance of desiccation in an insect leading to a femoral hernia which perforates to give rise to a surgical emphysema, these observations present two points of interest first, that in the desiccated condition the larvæ are apparently hygroscopic and can absorb water vapour from a moist atmosphere (though the possibility of their taking up minute droplets of fluid condensed on the proboscis has not been entirely excluded), and secondly, that small foreign bodies, such as the blood corpuscles of vertebrates, can circulate in the blood stream, apparently indefinitely, without being removed by phagocytosis or otherwise

I am indebted to Dr H B Newham for taking the photographs of living *Cimex*

V B WIGGLESWORTH

London School of Hygiene and Tropical Medicine, Jan 22

Conjunctival Halos

THE letter on this subject from Mr Sidney Melmore, in NATURE of Jan 3, leads me to describe an experience of my own which may be of some little interest Recently I was accidentally struck in the right eye with a dog whip, and I was conscious of a faint mistiness in front of that eye But I was surprised to find on looking at an electric light, on the same evening, that it was surrounded by a set of diffraction halos, two orders being visible Unlike the case described in Mr Melmore's letter, the space round the electric light was white and only the red ring of the first order halo was visible whereas all the colours of the second order could be seen A very approximate measurement of the first red ring gave its angular diameter as 7°, in fair agreement with the value quoted in Mr Melmore's letter An examination of the eye in a mirror showed that it was bloodshot, but revealed no trace of any abnormality in the part of the cornea immediately in front of the pupil The intensity of the halos decreased with time, and they disappeared completely after five days It would be interesting to know the nature of the small particles responsible for the halos, and how they were produced by the blow

A W BARTON

Repton School, Derby

THE probable explanation in Mr A W Barton's case is a transient œdema of the corneal epithelium, produced by the blow The basal corneal epithelial cells average about 10μ in breadth by 18μ in height, and the other epithelial cells are somewhat smaller These elements appear to be of about the right order in size

J HERBERT PARSONS

54 Queen Anne Street, Cavendish Square, W

Embryology and Evolution

IN the issue of NATURE for Feb 7, p 200, Mr Malcolm E MacGregor revives a form of vitalism that has lain dormant for a number of years, and well might it have been permitted to do so for as many more It is surely well recognised that science is only a conceptual scheme which presumably bears some relation to the percepts that it attempts to correlate What lies outside that scheme may indeed be of the greatest importance, but it is not science Mr MacGregor adduces no evidence that the force primarily operating the living cell is an external one His wishes would be equally fulfilled by some form of hylozoism, but then it would be very difficult to acclaim the view as likely to be a guiding star for biological advance If one wishes to hold such vitalistic theories as being true, one cannot remain immune from scientific attack except by rigid adherence to some form of dualism, such as that of the great Nicholas of Cusa. Thus, if it be contended, as he did, that there is an external form of experience subject to natural law but separate from an inner form that has no relation to such law and is beyond reason, then no scientific criticism is possible

The sterility of vitalistic hypotheses in the past leads one to doubt their fertility in the future, and the deification of entelechy does not carry us far

A PINEY.

Woodham Mortimer Hall, Maldon, Essex, Feb 6

The Photo-Reaction of Hydrogen and Iodine Monochloride

WE are able to confirm the observations of D P Mellor and T Iredale [1] on the photo reaction between iodine monochloride and hydrogen, as against the photo inactivity of the mixture reported by Rollefson and Lindquist [2] A rapid photo reaction between these substances when not specially purified had been observed by us before the appearance of Rollefson and Lindquist's paper, the reaction, however, is much influenced by traces of impurities, for when special pains are taken to avoid contamination by organic materials, stopcock grease and the like, the rate of reaction under the influence of light is much decreased There remains, however, an easily measurable reaction under the influence of the light of a mercury arc The main products are hydrogen chloride (HCl) and iodine (I_2), no appreciable amount of hydrogen iodide has been found The photo reaction between iodine chloride and methane has also been established in this laboratory, the rate here is great compared with that of the hydrogen reaction Both reactions are being investigated in detail

S E ASHLEY
WILLIAM WEST

Washington Square College, New York University, New York, Feb 2

[1] NATURE 127, p 93 Jan, 17 1931
[2] *Jour Amer Chem Soc*, 52, 2793 1930

Growth Factors

IN a recent communication (*Proc Physiol Soc*, October 1930) Thompson demonstrated that by certain methods of extraction a growth inhibiting substance could be obtained from fresh parathyroid glands Further work in this laboratory has shown that a similar substance can be extracted from the flesh of vertebrates Purification of such extracts shows that the substance responsible is thermo stable, is not a sterol, and is probably nitrogenous

W J BOYD
J LATTER
W ROBSON

Departments of Physiology and Botany, King's College, University of London, Feb 23

Transmission of *Leishmania donovani*

WE have received the following telegram from New Delhi, dated Feb 19

"Lieut Col Shortt reports successful transmission of *Leishmania donovani* to Chinese hamster by bites of artificially infected *Phlebotomus argentipes* Hamster bitten repeatedly during twelve months, generalised infection found seventeen months after experiment began —Scientific India"

We understand that the telegraphic address "Scientific India" refers to the Scientific Advisory Board of the Indian Research Fund Association.

Scientific Congresses in 1931.

During the summer of this year five important scientific gatherings will take place in London, all of which will be of an international character The first of these will be the International Congress of the History of Science and Technology, the second the jubilee celebrations of the Society of Chemical Industry, the third the International Illumination Congress, and the fourth and fifth the centenary celebrations of the discovery by Faraday of electromagnetic induction and the centenary meetings of the British Association Though the programme of the International Illumination Congress includes meetings at Glasgow, Edinburgh, Sheffield, Birmingham, and Cambridge, the delegates will meet in London before visiting the provinces, while the meetings of the other bodies will be held entirely in London

Organised by Le Comité International d'Histoire des Sciences, of which the permanent secretary is Prof Aldo Mieli, the Second International Congress of the History of Science and Technology is supported by Le Comité International des Sciences Historiques, the Newcomen Society for the Study of the History of Engineering and Technology, and the History of Science Society, and the aim of the Congress is to provide opportunity for intercourse and exchange of thought between all those who are interested in the various departments of the history of science and technology The programme has been arranged to cover the period Monday, June 29, to Friday, July 3, and the headquarters of the Congress will be the Science Museum Besides scientific communications, there will be social gatherings, visits to historic institutions, and excursions to places of scientific interest The president is Dr C Singer, the honorary treasurer Sir William Bragg, and the honorary secretary Mr H W Dickinson, Science Museum, South Kensington, S W 7, from whom further particulars can be obtained The Congress, it may be added, originated with the Comité International d'Histoire des Sciences, which was founded at Oslo on Aug 17, 1928, and meets annually in Paris

The jubilee celebrations of the Society of Chemical Industry, it has been announced, will be of a domestic character, the functions being thrown open only to members and a very few distinguished guests who will be the recipients of special honours The Society was founded in 1881, and to-day has upwards of 7000 members, associate members, and subscribers The meetings will commence on July 13 and will extend over the succeeding seven days It is hoped the Lord Mayor of London will open the proceedings by receiving the delegates at the Guildhall, and succeeding events will include the annual dinner, the annual general meeting, the delivery of the presidential address, and the presentation of the Society's Medal Visits to many works typical of the manufactures of London are being arranged, the Chemical Engineering Group of the Society is arranging an exhibit of special recording and measuring instruments in the Central Hall, Westminster, where there will also be an exhibit of British chemical plant arranged by the British Chemical Plant Manufacturers' Association. To mark the occasion permanently, Dr Stephen Miall, editor of *Chemistry and Industry*, is writing a history of the chemical industry, to be published at a low cost immediately prior to the meeting, and a special jubilee number of the *Journal* of the Society will be published containing reprints of outstanding papers, biographies of presidents, medallists, and honorary members, and a history of the Society While the preliminary programme was being arranged, the late Lord Melchett held the presidency of the Society, but he has now been succeeded by Sir Harry McGowan The headquarters of the Society are at Central House, 46 Finsbury Square, E C 2, Mr H J Pooley being the general secretary

The meeting of the International Illumination Congress, the ninth of its kind, will be divided into two parts, the first part consisting of a Congress which will be held on Sept 2–12, and the second part consisting of meetings of the technical committees of the International Commission on Illumination, to be held on Sept 13–19 The Congress, of which Mr C C Paterson is the president, is being organised by the National Illumination Committee of Great Britain, in co-operation with the Illuminating Engineering Society, 32 Victoria Street, S W 1, Col C H S Evans being the honorary general secretary After assembling in London on Sept 1–3, the delegates will then spend two days at Glasgow, three days at Edinburgh, two at Sheffield, two at Birmingham, and the remainder of the time, Sept 13–19, at Cambridge At the latter place will be held the plenary session of the International Commission on Illumination A comprehensive list of subjects for discussion has been drawn up, and papers will be presented on the lighting of factories, offices, houses, vehicles, streets, museums, and lighting for traffic control, together with others on lighting for aviation and navigation, flood lighting, architectural lighting, laboratory technique, and the lighting of mines Many institutions are represented in the general council of the Congress, the chairman of which is Lieut-Col K Edgcumbe The first three International Illumination Congresses were held at Zurich, and the others have since been held at Berlin, Paris, Geneva, Bellagio, and Saranac, New York

We have on a previous occasion referred to the general arrangements for the commemoration of the centenary of Faraday's discovery, which are in the hands of the Royal Institution and the Institution of Electrical Engineers While these two institutions have joined forces in making the plans, they are indebted to other societies for their cooperation Thus, the Royal Society will entertain the delegates to the celebrations, the Federal Council for Chemistry will participate in the arrangement of the Faraday Exhibition, and assistance has been offered by Government, university, and other bodies with scientific interests The provisional programme includes the reception of the delegates in the Lecture Theatre of the Royal Institution, and the Faraday commemoration meeting at the

Queen's Hall on Sept 21, conversaziones at the Royal Institution and the Institution of Electrical Engineers on Sept 22, and the opening of the Faraday Exhibition at the Albert Hall to the public on Sept 23 This exhibition will remain open for about ten days, and it is hoped to publish a catalogue and description of it The preparation of a souvenir of the whole celebrations is under consideration, and progress is being made with the preparation for publication of Faraday's famous diary Of the six or eight volumes in which the work will ultimately be completed, it is hoped to have one or possibly two ready by September

The second day of the Faraday celebrations, Sept 22, will coincide with the opening of the summer meeting of the Institution of Electrical Engineers, while the third day, Sept 23, will be the commencement of the centenary meeting of the British Association for the Advancement of Science, which has not hitherto met in London During the afternoon of Sept 23, Lieut Gen the Right Hon J C Smuts will be installed as president of the British Association and a reception of delegates will be held in the Albert Hall, this arrangement allowing the members to have a private view of the Faraday Exhibition On the same evening General Smuts will deliver his address at the inaugural general meeting in the Central Hall, Westminster The sectional and other scientific transactions will be carried on daily from Thursday, Sept 24, until Wednesday, Sept 30, inclusive For the majority of these transactions meeting rooms will be used in and near Exhibition Road, South Kensington, while the reception room will be in the Great Hall of the University of London A preliminary notice has been issued by the Association giving the names of the presidents of the thirteen sections, among whom are Sir J J Thomson, Sir Alfred Ewing, Sir Halford Mackinder, Sir Harold Hartley, Sir C Grant Robertson, and Sir John Russell The usual programme of visits and excursions will be arranged, and in view of the very large number of institutions and buildings, houses, and memorials in London connected with the scientific men of the past, and the wealth of scientific work now being done in the metropolis, these should prove of wide and general interest A large attendance of scientific workers from both the Dominions and foreign countries is expected, for whom the Association hopes to obtain private hospitality by residents in London The full preliminary programme is expected to be issued in April, and this will be obtainable from the Secretary, British Association, Burlington House, W 1

In addition to these congresses, two other scientific gatherings of unusual interest will be held in Great Britain At Manchester on Mar 17 the Manchester Literary and Philosophical Society will commemorate the 150th year of its foundation, while at Cambridge on Oct 1–2 the centenary of the birth of James Clerk Maxwell will be celebrated Founded in February 1781, the Manchester Literary and Philosophical Society will always be associated with the work of Dalton, who for half a century was a member Other distinguished scientific men connected with the Society include Joule, Sturgeon, Hodgkinson, Fairbairn, Nasmyth, Wilde, Osborne Reynolds, Balfour Stewart, and Roscoe The commemoration will include an address in the Athenæum Hall by Sir J J Thomson, to whom the Dalton Medal will be presented, and a dinner in the Midland Hotel During the week the Society's house, 36 George Street, will be open to visitors At the Maxwell centenary celebrations at Cambridge, addresses will be given by Sir James Jeans, Sir Joseph Larmor, Sir J J Thomson, and Profs Einstein, Langevin and Planck Maxwell was born on June 13, 1831, and died on Nov 5, 1879 He was the first Cavendish professor of experimental physics and the founder of the great school of experimental physics at Cambridge His contributions to optics, geometry, molecular physics, and other subjects are to day less widely known than his fundamental work on electromagnetic theory, and his connexion with Faraday makes it appropriate that his centenary should follow the September celebration of the centenary of Faraday's discovery of electromagnetic induction

Glasses for Use with Invisible Rays *

By Dr S English, Holophane Research Laboratory

WHENEVER light is produced, invisible radiations—ultra-violet (U V) or infra red (I R)—are, almost without exception, produced at the same time Glasses which are transparent to the visible rays are not necessarily transparent to either the ultra-violet or infra-red, and similarly, opacity to one set of radiations does not imply opacity to the other two sets In order to control these invisible rays, therefore, it is necessary to have ranges of glasses for transmitting and for absorbing these various bands of rays

Ultra Violet Radiation

Of recent years the extraordinary biological activity of a small band of ultra-violet rays lying near the extreme end of the sun's spectrum, and extending from this wave-length (295 $M\mu$) up to about 320 $M\mu$, has established the fact that though ordinary glass, as used for windows and artificial lighting equipment, is transparent to the longest ultra-violet rays, it becomes opaque at about 310 320 $M\mu$ It is thus useless for transmitting rays of the biologically active wave-lengths Several types of glass have been developed which are transparent to these so-called 'health rays', and to a limited extent to radiations of rather shorter wave lengths than are found in the sun's spectrum

Investigations in this field have proved that silica and boric oxide are the best two materials for making glass with a good transparency for the ultra-violet, while iron oxide and titania are the two most dangerous oxides in this respect In

* Substance of a paper read before the Illuminating Engineering Society on Dec 12

making U V. glass, besides reducing the amount of iron oxide entering the glass from various sources, it has been found necessary to melt the glass under chemically reducing conditions, for ferric oxide reduces the U V transparency much more than does a corresponding amount of ferrous oxide For this purpose organic reducing agents are generally used, but recently, in some cases, inorganic reducing agents have been used very successfully With these inorganic reducing agents it is possible to obtain a higher proportion of the total iron oxide content of a glass in the ferrous condition, and as a result the colour of the glass through a considerable thickness is pale blue, whereas the colour of glass reduced with organic agents is pale green or blue green, or it may be a pale amber colour if too much carbonaceous matter has been used

In connexion with that much-debated matter, the ageing of U V glasses, it has been shown that certain types of glass more easily lose a certain proportion of their transparency to the ultra-violet than do others This loss of U V transparency appears to be due to the reoxidation of the ferrous iron in the glass to the ferric state, a process which proceeds slowly under the influence of direct sunlight until an equilibrium between the relative amounts of the two oxides is reached When once this equilibrium is reached, no further loss of U V transparency occurs unless the conditions of exposure are altered The extent of this loss of U V transparency depends on the total iron oxide content of the glass and on the conditions of manufacture, it varies from so low a figure as 7 per cent at 300 Mμ for one type of glass up to 20 per cent or more for other types

For the manufacture of medical and scientific U V lamps, clear fused quartz is an ideal material, but it is too transparent to the shorter ultra violet rays and too expensive when worked into the desired sizes and shapes that are required for certain new types of U V lamps These lamps, it is claimed, give sufficient ultra-violet light of the active wave-lengths to produce a light erythema, but, it is also claimed, they are safe to use—continuously without medical supervision—either as a substitute for, or in parallel with, ordinary artificial lighting One of these lamps consists of a daylight blue globe of U V transparent glass surrounding a tungsten filament, which is distinctly over-run, so much so that its average life is reduced to 300 hours Another lamp has a clear U V glass bulb containing a drop of mercury, a tungsten filament, and tungsten electrodes between which a mercury vapour arc is struck almost as soon as the lamp is switched on, the heat from the filament being sufficient to vaporise enough mercury to start and maintain the arc (Fig 1) A third lamp of this type is a low-pressure mercury arc enclosed within a vitreosil tube which is surrounded by a framework carrying sheets of U V glass The lamp is meant for use along with ordinary artificial lighting units

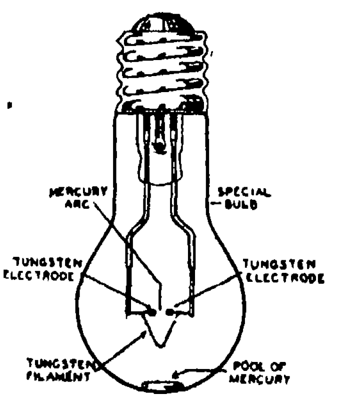

FIG 1 —New type of U V lamp

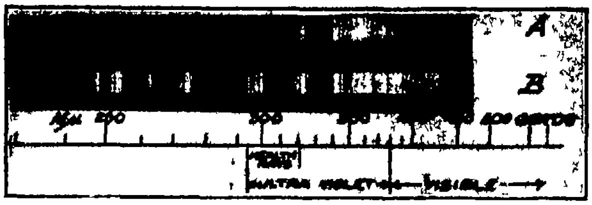

FIG 2 —A, iron arc through Wood's glass, B, iron arc

Glasses containing sufficient nickel oxide on a potash base to colour them a very deep blue are so deep that in thicknesses of 3 mm they are opaque to ordinary light, but are transparent to ultra-violet rays from about 390 Mμ down to about 310 Mμ (Fig 2) They are referred to as Wood's glasses With such glass it is possible to have a room completely dark but flooded with ultra violet rays that only need to impinge on suitable fluorescent materials to reveal their presence One such material is the so called canary glass, which owes its fluorescent properties to the presence of a small percentage of uranium oxide on a soda lime base Under the action of ultra-violet rays, this glass shows a very strong greenish-yellow fluorescence Certain other glasses show a weak fluorescence, but none of them is in any way comparable to uranium glass in this respect Besides its attempted use in invisible signalling, Wood's glass is finding many avenues of usefulness in research and commercial laboratories

For absorbing ultra-violet rays while at the same time transmitting the visible spectrum without very much selective absorption, there are several glasses available, all based on Sir William Crookes's work, and all containing, as an essential constituent, cerium oxide If selective absorption in the visible region is not objected to, then an amber-coloured glass made by the inclusion of iron oxide and manganese dioxide in the batch is very effective in absorbing ultra violet rays

INFRA RED RADIATION

On turning to the infra-red rays, extending from 0 78 μ upwards, we again have three types of glass (1) for transmitting both visible and infra-red rays, (2) for transmitting the visible and absorbing the infra-red, and (3) for absorbing the visible and transmitting the infra red Considering them in this order, fused quartz, which of course transmits the vision rays freely, also transmits the infra-red radiations up to a wave-length of about 5 μ It is not to be expected that glasses containing 70-75 per cent of silica will show any better infra-red transparency Soda and lime, the other principal constituents of ordinary glass, appear to cause a

slightly decreased infra-red transparency, but this may be due to small amounts of impurities that are usually found in such glasses

Sir William Crookes, in his work published in 1914, showed that many oxides conferred on glass the property of absorbing the infra-red rays to varying extents Most of these oxides also gave a distinct colour to the glass He also showed that by far the most effective material for this purpose was iron oxide melted into the glass under reducing conditions In his work Crookes measured the infra-red radiation transmitted through his glasses by the total heating effect His general conclusions have recently been confirmed by the work of Gehlhoff, Schmidt, and Thomas, who have determined the infra-red transmissions at various wave-lengths

Several heat-absorbing glasses are available They all employ iron oxide in the reduced condition, the only essential difference being the means that are employed to obtain the iron oxide in the ferrous state Generally the iron and its reducing agent are introduced together by using iron oxalate as Crookes did Recently, however, attempts have been made, with a certain degree of success, to use inorganic reducing agents, which retain a greater proportion of the iron in the ferrous state Such glasses are blue-green in colour, instead of the green of ordinary iron-containing glasses

Measurements show that the heat absorption of glasses of this type is to a certain extent related to the colour of the glass, but there is no close parallel, as is shown in the accompanying table

Light Transmission and Heat Absorption of Various Glasses, 2 5 3 0 mm Thick.

Glass	Percentage heat absorption.	Percentage light transmission.		
		Red	Green	Blue
H (Clear)	74	59	72	71
T (Clear)	72	59	71	71
C (Cath)	93	17	36	35
A (Clear)	79	59	75	75
5 (Experimental)	86	50	70	69
12 (Experimental)	93	25	45	44

As a last type of glass to be considered, there is a very interesting glass which has the power of absorbing all visible rays but transmitting infra-red rays Such a glass, of course, appears black in thickness of 2 mm and upwards, but in very thin sections it has a reddish amber colour As a means of invisible signalling, this glass has almost, if not quite, superseded Wood's glass, since infra-red rays are easier to produce in quantity than ultra-violet rays , they also have the great advantage of carrying farther, as they are not so easily absorbed by the atmosphere For burglar alarms and apparatus of that type, this glass has an interesting field of usefulness

British Industries Fair.

THE British Industries Fair, 1931, to which brief reference was made in our last issue (p 281), has exceeded its previous records in the total area occupied by the stands, in the number of exhibitors, and probably, also, so far as the evidence is available at the time of writing, in the number of overseas and home buyers, as well as of the general public, that have visited it The integrated effort to demonstrate visually the extent, variety, and quality of the products of British industry required this year no less than four separated, but not unrelated, exhibitions for the light industries, at Olympia, London , for the heavy industries, at Birmingham , for textiles, at the White City, London , and for artificial silk goods, at the Albert Hall, London In the critical industrial period through which the country is now passing, the Fair was a remarkable and bold achievement, and tribute must be paid to the Department of Overseas Trade, to the Birmingham Chamber of Commerce, and to the various trade and industrial organisations, as well as to individual firms, that co-operated in its organisation Information is not yet available, but will be eagerly awaited, as to the business orders that have been received for British goods, as the direct result of the Fair

It will not be possible to review, even cursorily, the exhibits shown at the four separate sections of the Fair mentioned above, but it may be worth while to record a general impression of the exhibitions at Olympia It is difficult to believe that any visitor could thoughtfully go through the Fair without being greatly impressed by the vast range, the great variety, the excellent quality, and often, be it said, the great beauty of the goods displayed Despite the disheartening aspect of our unemployment figures and the faintness of our hopes of an early industrial revival, the evidence that Olympia afforded of the vigour and quality of so many British industries was reassuring and uplifting An industrialist, recently returned from journeying overseas, related that, in foreign countries and in the British dominions overseas, he had again and again noted how confident was the expectation that, whatever might happen in other countries, Great Britain at least would win through the difficulties of the world slump What could be seen at Olympia went far to justify this confidence In the heavy industries and in the great staple exporting industries, Great Britain has been for so long in the forefront that the quality of their products has almost come to be taken for granted, but even in those lighter industries associated in the popular mind with foreign manufacture—for example, toys and certain kinds of fancy goods—the exhibits at Olympia provided striking evidence of the progress that has been made by British manufacturers

The grouping of the exhibits according to industries was not only convenient for the buyer and

visitor, it necessarily created a series of mass effects also, so that it was impossible to escape getting, from each group, a general impression of the respective industry as a whole In this regard, the china, earthenware, stoneware, and glassware exhibits formed a notable display, which included, it may incidentally be noted, some remarkably beautiful developments in decorative glassware It is well worth the consideration of future exhibitors how they may develop what may be called the organised group exhibit There can be no doubt that, so far from exhibitors losing anything by close association of their exhibits with those of similar, and even competitive, firms, they gain in mere advertisement value from the mass effect produced by the associated exhibit The individual firm must ultimately benefit from any good impression created of the whole industry of which it is a constituent

In this connexion, special praise should be given to the exhibit of the British scientific instrument manufacturers, which this year excelled, in area, in the number of exhibitors, and in the range and variety of exhibits, the achievement at last year's Fair The total effect of the two great contiguous stands on which the British optical and scientific instrument manufacturers had arranged their exhibits was an assurance of the vitality and a guarantee of the future of this important British industry Perhaps one of the most striking features of these associated exhibits was the manifestation of the extent to which scientific instruments are being used in all sorts of other industries in which, not so very long ago, they were unknown In order to direct attention to this modern development, the exhibiting manufacturers published a brochure, for distribution at the Fair and otherwise, on scientific instruments in industry, from which it is interesting and encouraging to learn *inter alia* that ninety per cent of the cinematograph-taking lenses used at Hollywood are of British manufacture, and that an equal or even a greater percentage of the best cinematograph projectors used in the United States are fitted with British lenses The exhibits on the combined stand of specimens of optical glass, of photographic lenses, and of prismatic binoculars lent point to the remarkable tribute paid to the superiority of certain British over corresponding foreign optical products in a letter by Dr C V Drysdale, Director of Scientific Research at the Admiralty, which appeared in the *Times* of Feb 14 That letter, as its writer claimed, but confirmed and amplified the statement made in a letter in the *Times* of Oct 19, 1925, from Dr Drysdale's predecessor in office, Dr (now Sir Frank) Smith

"It is a commonly held belief that optical instruments and optical glass of British manufacture are inferior to the instruments and glass produced by certain well advertised Continental firms and sold in large quantities in this country I wish to state that this belief is erroneous, and that it is based on prejudice rather than upon a knowledge of the facts Comparative tests made with rigid accuracy in the laboratory, and trials under stringent service conditions, prove that British optical instruments and glass are inferior to none"

We have not space to notice, by way of example, more than a few of the instruments exhibited by the British scientific instrument manufacturers Various types of temperature indicating and recording instruments, for use in industry, were shown by the Cambridge Instrument Co, Ltd, and by Negretti and Zambra The display of microscopes by R and J Beck, Ltd, W Watson and Sons, Ltd, James Swift and Sons, Ltd, and Charles Baker ranged from the simple student's form to the elaborate research microscope, and included types designed specially for industry Adam Hilger, Ltd, showed, besides an interferometer, a colorimeter and a spectrograph, a 'steeloscope' which has been produced for the rapid identification, by visual observation by unskilled labour, of different varieties of steels Newton and Co showed an epidiascope, ingeniously fitted with mirrors so as to increase the illumination of the object to be projected, and Charles Baker had an epidiascope fitted with a fan to prevent the evil effects of overheating Among the navigating instruments shown, reference may be made to a dead beat compass shown by Henry Hughes and Son, in which increased steadiness and damping are secured by an ingenious use of fine radial filaments Messrs Ross, Ltd, exhibited, besides their great range of photographic lenses, a cinematograph projector and a telescope of exceptionally light design, in which the body tube is of light fabric instead of metal, and which was mounted on a light and easily folded tripod Ensign, Ltd, had an interesting and recently designed aerial camera

Of the other scientific exhibits displayed at Olympia, mention must be made of the Chemical Section The Imperial Chemical Industries, Ltd, relied mainly, as last year, on a small cinema in which films were shown of the manufacture of some of their typical products, as well as of the social welfare work associated with the various units of this great organisation The stands of the gas companies and of the various chemical manufacturing firms showed almost a bewildering range of exhibits, from the simplest raw materials to the most refined analytical reagents and 'fine' chemicals Hopkin and Williams, Ltd, for example, showed a collection of radioactive uranium bearing minerals and the products obtainable from them, and also an exhibit of barium sulphate for X-ray diagnosis

It would be but random selection to refer further to particular exhibits Taking the Fair, as it could be seen at Olympia, as a whole, it was a noteworthy and encouraging demonstration that Great Britain is still in the forefront of the manufacturing nations of the world It is to be hoped that all the thoughtful planning, the careful organisation and the zealous co-operation that went to the making of the Fair will have their merited reward in a great and needed stimulus to British industry

Obituary.

The Hon Sir Charles Algernon Parsons, O M, K C B, F R S

By the death of Sir Charles Parsons on Jan 12, while on a voyage to the West Indies, the world has lost the greatest engineer engaged in the production of power from steam since the time of Watt It is due to his genius and perseverance that the steam turbine now produces practically all the electricity derived from steam power and every fast ship of large size, both naval and mercantile, is driven by steam turbines

Sir Charles, who was in his seventy seventh year, was the fourth and youngest son of the third Earl of Rosse, who built the great 6 ft telescope at Birr, Ireland He was educated privately and at Cambridge, where he was eleventh wrangler He became a pupil at Elswick Works and in 1883 joined Clarke, Chapman and Co of Gateshead, where he made his first steam turbine of 4 h p , which ran at the unprecedented speed of 18,000 revs per minute The design of the dynamo to be coupled to it—and it must be remembered that the design of electrical machinery was in its infancy then—was quite as great a feat as the steam turbine itself With increasing size, and improvements in design, the efficiency of the steam turbine increased until in 1888 a 32 kw machine running at 8000 r p m with 100 lb per sq in saturated steam and non-condensing gave a consumption of 51 lb per kw hour, a figure that would be good even at this day

In 1889 Parsons parted company from Clarke, Chapman and Co and started the Heaton Works, Newcastle-on-Tyne, to manufacture steam turbines and other steam and electrical machinery Here he met with the great setback that Clarke, Chapman and Co retained his original patents for turbines with the steam flow parallel to the axis He, however, designed a turbine clear of the original patents with the steam flowing radially, which, with the addition of condensing, culminated in a 100 kw turbine running at 4800 r p m giving the then record consumption of 27 lb per kw hour with 100 lb per sq in steam pressure, 50° F superheat, and 27 in vacuum

In 1894, however, as Clarke, Chapman and Co had failed to make a success of the steam turbine, Parsons got back his original patents for a fraction of the sum originally asked for them, and the parallel flow turbine was reverted to, in a form, except for size and improvements in construction and design, essentially the same as the reaction turbine of to-day In the forty-five years that have elapsed from the time he made his first turbine, the size has increased from the 4 kw turbine of 1884, which is now in the Science Museum, South Kensington, to 50,000 kw and even 200,000 kw

In the same year Parsons resolved to apply the steam turbine to marine propulsion, and an experimental boat, the *Turbinia*, of 40 tons displacement, was built At first it had one turbine, but, on account of what was then the little-known phenomenon of cavitation, not more than about 20 knots was attained For one turbine, three in series were substituted, and on each of the three shafts there were three propellers, and thus, in 1897, the then record speed of 34 knots was attained Two destroyers followed, one of which attained on trial 37 knots—which, it must be remembered, was obtained with coal and not oil fuel Unfortunately, both these were lost at sea about 1901, due to causes which had no relation to the turbines Soon afterwards two comparison ships, the *Amethyst* fitted with turbines and the *Topaz* with reciprocating engines, were built by the Admiralty, with the result that the performance of the turbine ship was much the better As a result, in 1905 turbines were fitted into the battleship *Dreadnought*, and then became the standard for the Navy On the mercantile side the growth was also very rapid, culminating in the *Mauretania* of 40,000 tons displacement and 68,000 s h p , which was designed in 1904 and finished in 1907, or just ten years after the *Turbinia* of 40 tons displacement In 1912 the difficulty of a slow-speed turbine having to be coupled to a high speed propeller was overcome by the introduction of gearing enabling each to run at the most suitable speed, and geared turbines have now become standard practice In 1926 a further step was made in the *King George V* , a Clyde passenger boat, where a steam pressure of 550 lb per sq in was adopted

Besides steam turbines, Parsons had many other interests he made several experiments with very high pressures and temperatures, a 2000 ton press and large storage battery being installed for this purpose, chiefly in the hope of being able to make diamonds but without success He also experimented on still higher pressures by firing steel bullets into a block of steel having a hole the same diameter as the bore Another experiment was to fire a large shot into a chamber containing a mixture of acetylene and oxygen, where it was estimated a temperature of some 16,000° C was attained on the explosion of the gases None of these gave any result The reproduction of sound was another of his activities , he made a valve worked from a gramophone or violin which, when supplied with compressed air, gave a great augmentation of sound combined in many cases with improved quality

Parsons was always interested in optical work largely inherited from his father, and so early as about 1887 devised greatly improved methods of producing search light reflectors, resulting in Heaton Works constructing nearly all the parabolic search light reflectors made in Great Britain He also made reflectors with one axis a parabola and the other a hyperbola or ellipse, so as to give a flat beam for use on the Suez Canal or other purposes By taking over the Derby Crown Glass Works where he was able to make many improvements in the manufacture, he to a large degree saved the production of optical glass in Great Britain , and he also had a controlling interest in Messrs Ross Ltd , makers of binoculars and other optical instruments He also took over the telescope works o

Sir Howard Grubb, F R S , which are now carried on at Walker Gate, Newcastle-on-Tyne

Sir Charles was a firm believer in the importance of research in industry, and very large sums were set aside for this purpose Also, accurate tests were invariably made of each machine as it was made, so as to give data for subsequent designs He also firmly believed in the utilisation of what may be called highly educated labour, and had always on his staff university men and others with high education, but in all cases it had to be combined with good practical knowledge

The Royal Society elected Sir Charles a fellow in 1898, and he served on the Council in 1907–9, being a vice-president in 1908–9 , he was awarded the Copley and Rumford medals He was made a K C B in 1911 and received the Order of Merit in 1927 He was given many honorary degrees by various universities, and among other medals had the Grashof Commemoration medal of the Verein Deutscher Ingenieure, the Albert medal of the Royal Society of Arts, and the Faraday medal of the Institution of Electrical Engineers He was an early member of the Advisory Council of the Department of Scientific and Industrial Research, and was on numerous other committees

Sir Charles married in 1883 Katherine, daughter of W B Bethell, of Yorkshire, and had one son, who was killed in the War, and one daughter He was a large benefactor to science, giving £5000 to the Royal Institution and £10,000 to the British Association, besides numerous gifts to various institutions GERALD STONEY

IT is difficult to write of Charles Parsons, a great inventor, one to whom civilisation owes more than a friend's feeble pen can well express Try to picture the world without his inventions, in the days when Atlantic travel took place in ships like the old *Scotia* of the Cunard Line, or the first *Oceanic*, which, when the White Star Line started some sixty years ago, created so much interest on Merseyside Contrast these with the *Mauretania* and the *Lusitania*, the first great ships propelled by Parsons' turbine, or to come to our own days, with the Cunard *Aquitania* or the *Bremen* of the North German Lloyd Line Maybe in 1931 we pay too much attention to speed, but time has a high value, and the minutes saved for useful work by the invention, which startled the world when the *Turbinia* first showed herself at the Jubilee Review in 1897, total many millions in number These are due to Charles Parsons

But for far more than speed and comfort in ocean travel are we indebted to the turbine and its inventor Imagine modern life without electric power This is neither the place nor the opportunity to collect statistics and estimate the percentage of that power generated through Parsons' work on the turbine, generated, too, in a manner so efficient that it is scarcely possible to hope for an improvement— unless, indeed, another Parsons shows us how to use atomic energy For Parsons was never content to leave an invention until it was nearly perfect, nor was he stopped by difficulties which to many seemed insuperable At first, the turbine was not a great success , he knew how efficient it ought to be, and he reached his mark Kelvin well described his invention as the greatest advance in steam practice since the days of Watt

So, too, with other problems Parsons tried to produce a diamond, and at the end of his life agreed, no doubt, as Prof Henry E Armstrong has told us, that there is no valid evidence to show that it can be obtained by any of the hitherto asserted means , but the work is there, of the highest value—a contribution to knowledge impossible for any but a great man, applying to the problem all the resources of the engineer, all the inventive power of a brilliant mind

Nor were Parsons' powers less shown in his more recent work Telescopes and optical glass had for him a hereditary interest and so he applied his genius to replace English optical glass in the position it held before the days of Abbé and Zeiss, and he did it, while in quite recent years he was devoting himself to further Hale's plans for a giant reflecting telescope

Parsons made no special mark at Cambridge, where he graduated as eleventh wrangler in 1877 After the usual training of an engineer, he set to work to develop the turbine, but it was not until the end of the century that he received any distinct recognition

No one meeting Parsons casually would have recognised in the gentle, modest man, somewhat quiet and hesitating in speech and manner, one of the world's great benefactors In public he said little, but interest him in a problem, ask his advice on some knotty point of scientific or engineering practice, give him, perhaps, a little time for quiet thought, and your problem was solved, or if solution was not at once to be found, you were set on a track promising to lead to the desired end Moreover, if the attainment of that end seemed of importance, you secured for the rest of your journey the support and assistance of a most wise counsellor and, what is more, a most kind friend

For Charles Parsons was that to all who earned his friendship , and we, who have enjoyed it for the last twenty five or thirty years, are the poorer for his loss, happy though we are to have known such a man, and to have learned from him some of the elements of true greatness

R T GLAZEBROOK

I FIRST met Sir Charles Parsons when he was appointed by the Lord President to the Advisory Council for Scientific and Industrial Research, on the resignation of Prof Bertram Hopkinson owing to pressure of War work Thus he was not an original member of the Council as has been stated in some obituary notices, though he joined it in the course of its first year of work His acceptance of the office was a proof of his willingness to subordinate his personal views to the common good, for it was no secret that he thought the national

organisation of scientific research for industrial purposes would have been better placed under the ægis of the Royal Society than under the State Yet he was as regular and active a member of the Council at its long and anxious deliberations as any of that brilliant group of seven distinguished men of science who formed the first Advisory Council As he came to realise that the formulation of policy lay in fact, as it was intended to lie, with the Council rather than with the Minister or his officials, I think his old doubts disappeared, though he was always a little inclined to be suspicious of the 'machine', which, as the range of the Council's activities grew—and it grew very rapidly—necessarily entailed a great increase in administrative business and a corresponding enlargement of the Department This watchfulness was all to the good of the cause, for the bureaucratic spirit will always be destructive of the aims and ideals of any organisation for the promotion of research, and more particularly industrial research, in which the utmost degree of co-operation between interested and independent bodies and the largest measure of decentralisation are essential to success

Parsons was essentially a shy man, and his interventions in discussions at the Council were generally brief, and often by way of critical question rather than dogmatic statement The longest speech I ever heard him make was a remarkable analysis of the conditions necessary for the successful application of new inventions or processes in industry, made before a departmental committee appointed by the Lord President to consider the problem of adequate rewards to scientific workers in government service for discoveries made by them in the course of their employment He emphasised the comparative cheapness in time and money of small-scale laboratory research, and the high scientific ability, the costliness, and the patience needed for translating a new technique or process or device into industrial practice He maintained that for this part of the work, where the risks were greatest, the greater reward was justly given As a great industrialist himself, he would have liked to see, though he realised its inherent difficulty, direct assistance given to selected firms in working new ideas on a manufacturing scale Failing that, he was a whole-hearted supporter of the policy of establishing co operative research associations in the industries, for he hoped they would have a freedom in dealing with individual firms which was impossible to a department of State

In two directions this belief of Parsons was influential He was closely associated, as an original member of the Fuel Research Board established in 1916, with the late Sir George Beilby's scheme for the station at East Greenwich, where research into fuel problems is conducted both on a laboratory and a full manufacturing scale, and again, it was his active support which helped to secure for the British Scientific Instruments Research Association more generous and continuous assistance than was given to any other of these organisations A letter from the Director of Scientific Research and Experiment at the Admiralty to the *Times* of Feb 14, in which he records the proved superiority of British optical glass and optical instruments, is evidence of the wisdom of this policy Parsons was himself a prime contributor to this result, for after his retirement from the Advisory Council in 1920, he became not only chairman of the Scientific Instruments Research Association, but also successively the owner of the Derby optical glass works and the controlling influence in the famous firms of Sir Howard Grubb and Messrs Ross and Co

Parsons entered the glass and instrument industries with the same high courage which had created his great engineering firms, and certainly with no expectation of monetary reward He knew the conditions too well for that, but he remarked that he believed a good man of science ought to be able to make optical glass without a previous training in glass technique, and his family traditions gave him pride in a conquest which would benefit both science and his country I have always thought that his interest in glass had its origin in the work of his father, and in the researches he himself undertook at Newcastle on the large reflectors he manufactured there for search lights

I remember, when Parsons took me over his works shortly after the War, that he showed me the shop in which these great reflectors were made, and explained how he had solved the problem of annealing them to withstand the strains set up in use It was impossible to walk with him through his great works without realising that the research spirit informed the whole undertaking, while simultaneously the practical engineer was in control of every part He was intimately acquainted with every machine in his shops, and again and again he would stop to explain how a weakness had been removed or better performance achieved by his personal intervention Yet as we moved over to the small building in which he had for years experimented in the artificial production of diamonds, one began to realise the range of his interests, and his willingness to expend large sums and all his ingenuity on problems of no immediate practical importance

Parsons was not, I should think, an altogether easy man to work with No genius is Like most shy men, he was a keen observer and sometimes a sharp critic of others When he set himself to a task, he would work at it continuously, so he told me, for twenty-four or thirty six hours or longer at a stretch This intensity of application and speed must often have left his collaborators and assistants gasping behind him Yet no man, I believe, did more than he to train his men in the method of his work Had he been one half as careful of his own health as he was for that of his staff, this grave loss to industry, to science, and to Great Britain might have been postponed

H FRANK HEATH

WE regret to announce the following deaths:

Mr H O Beckit, reader in geography in the University of Oxford, on Feb 19, aged fifty-six years.

Mr G E Birkett, director of the Manchester and District Radium Institute, on Feb. 5, aged thirty-seven years

News and Views.

According to Dr. S. C. Lind, director of the School of Chemistry, University of Minnesota, research has shown that starting with a single, simple mother-substance, a complex mixture of hydrocarbons such as occur in natural petroleum may be synthesised by suitable reactions The latter include the application of heat and pressure and, what is perhaps more novel, the bombardment of the initial substance with the alpha rays from radioactive compounds The *Daily Science News Bulletin* issued by Science Service, D C, records a recent communication of Dr Lind's to the American Association for the Advancement of Science, and quotes him as saying "The simplicity of such a mechanism may lend indirect support to the old idea of an inorganic origin from one or a few hydrocarbon gases such as might be produced by the action of water on metallic carbides in the earth's interior On the other hand, it does not preclude animal or vegetable origin, but strongly suggests that the primary material, whether gaseous, liquid, or solid, is later subjected to thermal or ionic agents or both, which produce the complexity found in Nature"

While we may discern radioactivity in a new, but none the less possible, rôle in this (Dr Lind's) theory of petroleum genesis, any support to the moribund inorganic hypothesis, whether direct or indirect, must inevitably be completely razed by the overwhelming geological evidence now available with the progress of time and discovery of vast oilfields, the data of oil occurrence of which were not available to enlighten the earlier views But there is decided merit in the postulation of radioactivity as effecting some degree of ionisation of organic matter during the baffling process of destabilisation and actual formation of oil It is this phase of the genesis which is still so hazy, and anything that chemists can do to throw light on the reactions involved, either mechanism or process, will prove of unquestioned service to science But is radioactivity a potential function in the type of environment and at the comparatively shallow depth in the crust which modern views seem now to imply for the birth of the oil globule?

In 1929, a laboratory for the study of the cold working of iron and steel was established in the University of Sheffield and equipped by firms engaged in the steel wire and strip industries with a rolling mill and draw-bench for experimental work, a fellowship and two research scholarships were provided by the Ironmongers' Company This laboratory has now been at work for a session, and has in progress a programme of research on the influence of the conditions of drawing on the properties of steel wire, especially with regard to its resistance to fatigue, and special instruments have been constructed for the purpose of the measurements. The behaviour of the cold-drawn wire in torsion, both continuous and alternating, is found to give a convenient means of following the changes in the progressive stages of drawing The influence of the form of the die and of other factors on the properties of cold-drawn mild steel bars is also under examination The rolling programme consists in a study of mild steel strip of the deep-drawing variety, and instruments have been constructed for the measurement of the pressures during rolling, and of the energy stored in the cold-worked metal

At the Fourth International Congress for Psychical Research, which was held this year at Athens and of which the *Transactions* have recently been published (London Society for Psychical Research, 1930), Sir Oliver Lodge discussed the reasons for the non-recognition of psychical research by the majority of the scientific world It would appear that he is of the opinion that eventually the sheer weight of evidence will overpower this hostility, which he thinks arises partly from a pardonable scepticism and partly from a vague recognition of the significance of psychical phenomena and consequent upheaval of ideas which must follow the acceptance of their reality It may well be, however, that the chief reason that scientific men are chary of recognising psychical research is that they are unable to perceive the weighty mass of evidence of which Sir Oliver speaks These, *Transactions* indicate the kind of things which engage the attention of psychical researchers Here are tales of raps and lights, of falling mortar and broken crockery, and even of showers of pebbles—of which some, strange to say, seemed to come out of the medium's hair! We read of sacred oleographs oozing human blood one day and on another exuding an organism usually found in very foul water we are told of an incident where a ghost had to come back to earth to persuade a medium to burn some letters which suddenly appeared in her hands Even Sir Oliver Lodge tells us a story of an occurrence in the presence of Sir William Crookes "on a well-lighted" dining table and in "full light", whereas in what appears to be the actual record of the case, it states that the phenomena took place at night in a room lighted only by three spirit lamps From the official proceedings at the Congress it appears that the next meeting will be held in London in the autumn of 1932, on the occasion of the jubilee of the Society for Psychical Research Although the French, Italian, and American representatives seem no longer to be associated with the organisation controlling the International Congress, its continuance is assured so long as it is supported by the British and German national committees

The projected opening of the Cape Cairo flying route on Mar 5 gives interest to a paper on air communication in Africa recently read to the Royal Society of Arts by Mr G E W Humphery, and published in its *Journal* on Feb 6 The route will follow British territory in the main, although it starts at Cairo As far as Khartoum the direction is straight and there is little difficulty about landing grounds Then a difficult bit of country begins and continues almost as far as Lake Victoria. For some months in the

year much of that country is under water, and on this part of the route it will be necessary, for the present at least, to use flying boats that can alight on the Nile and the lakes It is hoped, however, that before long aerodromes will be available, making an aeroplane service possible From Kisumu on Lake Victoria to Cape Town the surface conditions of the country offer no difficulties in the provision of landing places, but the aeroplanes must fly at a considerable elevation The proposed route is via Nairobi, Broken Hill, Salisbury, Bulawayo, Johannesburg, and Kimberley Three types of air craft will be employed, changes being made at Khartoum and Kisumu Speed will be about 100 miles per hour throughout, and a weekly service for passengers and mails is proposed There will be no night flying, and the through journey will take eleven days The opening flight on Mar 5 will provide connexion with Kenya and Tanganyika, but the first through flight to the Cape will be deferred about three months

The aims and methods of the land utilisation of Britain were explained by Dr L Dudley Stamp in a paper entitled "Land Utilisation Survey" read before the Royal Geographical Society on Feb 16 The primary object is to make a complete record of the uses to which the land of Britain is put at the present time Six different categories are recognised meadow and permanent grass, arable land, including rotation grass, heathland and moorland, forests and woodlands, gardens, and land agriculturally un productive The survey is to be recorded on the 'six-inch' Ordnance maps This entails roughly 22,000 quarter sheets, each showing six square miles The work is being done by volunteer surveyors in various parts of the country and is of such a nature that schools can give valuable help The Board of Education has re commended it to the notice of schools and emphasised its educative value The sheets when marked are to be sent to the central office at the London School of Economics There they will be reduced to a one inch scale It is then planned to publish, through the Ordnance Survey, a series of sheets corresponding to the 'one inch' popular series Many areas of the country are already arranged for, and several hundred volunteers are at work It is obviously desirable that the whole country should be surveyed simultaneously, so that useful comparisons can be made and con clusions drawn on the existing state of agriculture The completed survey will give precise information where statistics can give only average information

At the meeting of the Royal Microscopical Society on Feb 18, Dr Robert Chambers, professor of biology in the University of New York, gave a remarkable demonstration of his method of micro-dissection and micro-injection in an address on "The Nature of the Living Cell" Probably the most striking peculiarity of living matter, or protoplasm, is the fact that it exists only within the confines of microscopic dimensions Protoplasm is protoplasm only in the form of living cells, plant or animal, therefore the only direct method of studying its properties is through the compound microscope under magnifications varying from 150 to more than 1000 diameters. The micro-dissection and micro injection technique of Prof Chambers was evolved in order to make it possible to manipulate the protoplasm within the living cell The apparatus is a mechanical device for controlling the movements of spun glass micro-needles and pipettes within the field of the microscope An apparatus of this kind, built in 1920, was first demonstrated before the Royal Microscopical Society about six years ago Since then several different types of instrument have been developed by various workers The present apparatus is a model based upon the original one of 1920, but has been modified from year to year by the addition of various improvements, and is so constructed as to permit operations upon the living cell under the highest magnifications By means of this instrument many new facts have been discovered regarding the physical and chemical properties of protoplasm We now know, for example, that the nucleus in many cells is a fluid body and is more alkaline in reaction than the cytoplasm in which it is immersed The oxidation intensity of living protoplasm has also been determined by the injection into the living cell of dyes which are reducible, thus, when the colour disappears upon injection and can be made to reappear by the injection of an oxidising agent, we can be fairly certain that the protoplasm had reduced it in the first instance Similarly, by this method, the physical properties of the hitherto hypothetically regarded cell membrane have been made the object of intensive study

The new series of *Bulletins* which are being issued by the Ministry of Agriculture and Fisheries are attractively produced on antique paper and bound in stiff cut covers *Bulletin* No 20 (1930), entitled "Some Beneficial Insects", was formerly *Miscellaneous Publication* No 37, but has been rewritten and, in its new form, is now in its third edition There seems to be no doubt that an increasing number of practical growers and others are interested in knowing something about those insects that confer benefit upon man and which, for this reason, should not be destroyed This bulletin provides the general inquirer with the elementary facts concerning the life and behaviour of insect parasites and predators It also gives some idea as to how, in some cases, it is possible to take advantage of their propensities and utilise them on a large scale for controlling noxious forms of insect life We can commend the bulletin as being one of considerable educational value for rural and other schools It explains and directs attention to an aspect of Nature too often overlooked The two coloured plates add to its utility, since they represent accurately some of the chief kinds of beneficial insects prevalent in Great Britain The bulletin may be obtained from the Ministry of Agriculture and Fisheries, price 4*d*, post free

In the Ministry of Agriculture's new *Bulletin* No. 9 (1930), entitled "Bee Keeping", what was originally a sectional volume of collected leaflets has been revised and largely rewritten It has been prepared for the information and guidance of those who wish to keep bees, and to assist those who have already

gained some experience of the craft It is written in a plain, non-technical style, and controversial matters, such as those concerning the causative agents of foul brood, for example, are obviously outside the scope of an elementary publication of this kind The bulletin contains 55 pages of text and 26 illustrations, and may be purchased direct from the Ministry of Agriculture and Fisheries, price 9*d*, post free We welcome the new series of bulletins thus inaugurated, for there are many subjects that lend themselves to this method of treatment Accurate up-to-date information and reliable illustrations are a *sine qua non* in such publications The two bulletins briefly referred to are essentially popular in character, and the question may be raised as to whether there is also an opening for a second series of a more technical description

In his presidential address to the American Society of Parasitologists (published in *Science* of Jan 9), Dr N A Cobb pleads for more adequate and more accurate treatment of the Nematoda in text books and in courses of zoology He attributes the present unsatisfactory teaching on this subject to the fact that *Ascaris* is so commonly regarded as typical of the Nematodes, and this is responsible for such statements as that the only sense organs are papillæ on the lips, whereas "there is no lack of sense organs" in Nematodes He admits the difficulties of classification and of laboratory studies on the free living forms, which outnumber the parasitic forms, but would, nevertheless, so far as morphology is concerned, relegate *Ascaris* to the background, as it is "devoid of a single curious or interesting external feature to attract attention" There is much to be said for his plea that the study of the group would be more satisfactorily approached by the microscopic examination of small, living, transparent forms These could be supplemented by the study of a transverse section, and for this purpose it would be difficult to find a better example than *Ascaris*, in which the histology, especially of the gut, muscles, and reproductive organs, is so diagrammatically clear The retention of *Ascaris* in this way in the practical course would afford the opportunity of directing the student's attention to the great historical importance of *Ascaris* in the development of our knowledge of germ cells and of the nature and behaviour of chromosomes and other cell elements

An interesting and suggestive subject is discussed by A S le Souef in the *Medical Journal of Australia* for November—"Actions, Reactions, and Traits common to Men and Animals" From his own observations in the Zoological Garden at Sydney and from the writings of other naturalists, the author has collected examples of activities in birds and beasts which recall human actions Some of these are the play of elephants, seals, and emus, the collecting instinct of many rodents and of bower-birds, which he suggests may be a forecast of the human collecting of birds' eggs and 'hard cash'; the song of birds and the dances of birds and monkeys, the thieving and the teasing tendencies of certain birds, instinctive fears, and so on It is possible that there may be a direct ancestral connexion between these animal actions and human actions, but it is unlikely, and Mr le Souef pushes his conclusion beyond the evidence when he states that "man in his body and mind and the resultant actions therefrom is an almost complete embodiment of the lower animals, combining in some degree the attributes of all species" Man, as a living being, possesses the functions common to all living organisms, and that these should sometimes find similar modes of expression, even in creatures which have no direct ancestral relation, like man and birds, is scarcely to be wondered at In these actions and reactions we are looking upon common expressions of the essential life activities, but perhaps this is all that Mr le Souef means

Volume 22 of the *Collected Researches* of the National Physical Laboratory is a quarto volume of more than 400 pages devoted entirely to electrical matters The 21 memoirs which are included have appeared in the *Proceedings* of scientific or technical societies or in other scientific publications during the past six years, and more than half of them during the last two years Five of the memoirs relate to the carrying capacity and other properties of cables used in power transmission and come within the purview of the Electrical Industries Research Association or the Engineering Standards Association One is devoted to the design of an air condenser which is a pure capacitance, and another to an accurate method of measuring dielectric constants of liquids The remaining memoirs deal with problems which have arisen in wireless telegraphy—the properties of the antennæ and of the beam propagated, the construction and performance of instruments or apparatus used in wireless measurements, including quartz oscillators, nine of these memoirs relate to researches which were undertaken for the Radio Research Board No one can look through the volume without being struck by the importance of the part the Laboratory is playing in the solution of the problems which arise in the work of the research associations which the industries have formed under the auspices of the Department of Scientific and Industrial Research

The 'Text' volume, the final one of the three annual volumes constituting the Registrar General's Statistical Review for 1929, has recently been published (H M Stationery Office 2*s* 6*d* net) It contains the official analysis of the vital statistics contained in Parts 1 (Medical) and 2 (Civil), issued recently The population (England and Wales) at the middle of the year is estimated at 39,607,000 persons—18,969,000 males and 20,638,000 females The figures indicate a higher growth among males, and the sex inequality, expressed as 1096 females in 1921, is thereby assumed to have been reduced to 1088 females, at the mid year, per 1000 males The deaths ascribed to cancer numbered 56,896, the highest number yet recorded for any one year There is a marked decrease of mortality from conditions associated with alcoholism Tables have been introduced

showing the mortality of the first 30 minutes of life, the reduction in the mortality from diabetes since the introduction of insulin (mortality from this disease at ages above fifty-five years, however, continues to increase), and reduction in the mortality from pernicious anæmia as a result of the new treatment with liver

The honour of knighthood has been conferred by the King upon Capt Malcolm Campbell for his achievement of the world's land speed record on Feb 5

An earthquake was recorded at Kew Observatory at 5 h 44 m 42 s G.M T on Feb 20 The epicentre is estimated to have been in Korea, near lat 39° N, long 126° E The initial impulse was very sharp, but the amplitudes of the main phase were small The shock is believed to have originated at a greater depth than usual, probably about 250 miles

Sir James Jeans has been awarded the Franklin Medal for 1931 by the Franklin Institute, Philadelphia, "in recognition of his many fruitful contributions to mathematical physics, especially in the realms of the dynamical theory of gases and the theories of radiation, and of his challenging explanations of astronomical problems and his illuminating expositions of modern scientific ideas"

It is announced in the *Times* that Capt W P B Beal, formerly principal veterinary officer of the Gold Coast, has been appointed superintendent of the new zoological park of the Zoological Society of London at Whipsnade Capt Beal has had considerable experience in supervising the health of animals, planning experimental stations, and road making, and will be largely engaged in the development of the Whipsnade estate It is expected that the new park will be open at Whitsuntide

Influenza has been prevalent all over Great Britain during the last few weeks, and for the week ended Feb 14 the deaths from this disease numbered 458 in England and Wales and 116 in London The disease is also widespread in the United States of America, and we learn from a *Daily Science News Bulletin* (Science Service, Washington, D C) that for the week ended Jan 31 a total of 8362 cases was reported to the U S Public Health Service

The Ministry of Health has issued a circular respecting the outbreak of paratyphoid fever in Essex Between Feb 1 and 14, 172 known cases have occurred in the Epping Urban, Epping Rural, and Loughton districts, and the Borough of Walthamstow The infection in all cases has been caused by the paratyphoid B type of bacillus, the illness has been severe in many cases, and up to Feb 21 seven deaths occurred The epidemic has been traced to infection of a particular milk supply at a dairy farm in the Epping Rural District. The infection appears to have been introduced by one of the employees on the farm, who, unknown to himself, was suffering from a mild attack of paratyphoid fever while at work and handling the milk before distribution

The third annual exhibition of apparatus relating to television, picture telegraphy, and talking films is to be held by the Television Society at University College, London, on April 15, from 2.30 P.M to 9 P M The Exhibition Committee invites offers from research laboratories and institutions and from individual research workers and those engaged in experiments in any of these subjects, such offers to be sent as soon as possible to the Hon Secretary, Mr W G W Mitchell, Television Society, 4 Duke Street, Adelphi, London, W C 2, and giving particulars of space and any other facilities required. As on previous occasions, members of the Society exhibiting apparatus have the right of entering their exhibit in the annual competition for the Tuke Cup, which is awarded by an independent committee of judges for the most meritorious exhibit, in relation to television or cognate subjects

A catalogue of second-hand books, some 500 in number, on botany, ecology, entomology, forestry, natural history, ornithology, zoology (invertebrate and vertebrate), has just been issued by Messrs W and G Foyle, Ltd, 119 Charing Cross Road, W C 2 Copies are to be had free upon application

The Prague Summer School was inaugurated last year to afford English speaking visitors, especially those interested in educational matters, an opportunity of attending a series of lectures on various aspects of Czechoslovak and central European civilisation and cultural life The Summer School will again be held this year during the long vacation, on July 20–Aug 8 The scope of the syllabus has been extended to include, in addition to other new subjects, an account of Czechoslovak contributions to the natural sciences. In connexion with the lectures a number of interesting excursions have been arranged so that members may see places of historical interest, the Karlsbad and Marienbad spas and springs, the radium mines at Jáchymov, etc The director of the Summer School is Dr B Trnka, 55 Smetana Square, Prague, Czechoslovakia

An advanced course in oriental studies will be held at the School of Oriental Studies, Finsbury Circus, London, on Mar 2, 3, and 4 The lectures will be given by Prof B Hrozny, professor of ancient eastern history in the Charles University of Prague, the subject being the "Excavations of Kultepe" and "The Hittites" The first lecture will deal with Prof Hrozny's travels in Asia Minor and the excavations at Kultepe which led to the discovery of the now famous Assyrian merchants' archives of 2000 B C This lecture will be illustrated by some hundred coloured lantern slides The second and third lectures, on the Hittites, will deal with the decipherment of the Hittite language and its recognition as Indo-European, the non-Indo-European Khattish and other newly discovered peoples of Asia Minor and North Mesopotamia, the Luish, in essence non-Indo-European, the Khurrish, who spoke a non-Indo-European language and are identified with the Horites of the Old Testament, and the Mitanni, who are of Aryan, or rather Indian, origin. Finally, Prof Hrozny will discuss the relations of

the Hittites and the Greeks At the first lecture the chair will be taken by Dr A E Cowley, Bodley's Librarian in the University of Oxford The lectures, which will be delivered in English, will begin on each day at 5 15 P.M, and admission will be free and without ticket

APPLICATIONS are invited for the following appointments, on or before the dates mentioned — A reader in statistics in the University of Cambridge —The Registrary, The Registry, Cambridge (Mar 4) A scientific instrument maker at the University College of South Wales and Monmouthshire—The Registrar, University College, Cathays Park, Cardiff (Mar 7) An assistant lecturer in science at the National Society's Training College for Teachers—The Principal, Training College, Berridge House, Fortune Green Road, W Hampstead, N W 6 (Mar 9) Senior technical assistants and technical assistants at Admiralty establishments near London and in Portsmouth—The Secretary of the Admiralty, C E Branch, Whitehall, S W 1 (Mar 10) A director of the Manchester and District Radium Institute—The Hon Secretary, Radium Institute, Nelson Street, Manchester (Mar 14) A lecturer in economic history in the University of Liverpool—The Registrar, The University, Liverpool (Mar 16) A principal and professor of organic chemistry at the Royal Institute of Science, Bombay—The High Commissioner for India, General Department, India House, Aldwych, W C 2 (Mar 21) A biochemist, a technician in the research laboratory, and a junior biologist, each under the Newfoundland Fisheries Research Commission—The Newfoundland Government Office, 58 Victoria Street, S W 1 (Mar 22) A professor of chemistry at the Heriot Watt College, Edinburgh—The Principal, Heriot Watt College, Edinburgh (Mar 26) A professor of mechanical engineering in the Engineering College of the Benares Hindu University—The Principal, Engineering College, Benares Hindu University, Benares, India (April 5) A principal of the Northern Polytechnic—The Clerk, Northern Polytechnic, Holloway, N 7 (April 17) Lecturers in, respectively, pure mathematics, civil engineering, and botany in the Queen's University of Belfast—The Secretary, Queen's University, Belfast (April 19) A lecturer in geography and elementary science at the Truro Training College—The Principal, Training College, Truro A lecturer in physical training and hygiene at Southlands Training College—The Principal, Southlands Training College, Wimbledon Park Side, S W 19

Our Astronomical Column

A Large Sunspot —A large group of sunspots recently visible is the largest that has appeared for over a year The group when near the sun's east limb on Feb 14 was quite small, but between Feb 17 and 19 it developed rapidly, and by Feb 21 had become a conspicuous stream of spots easily visible to the naked eye The central meridian passage of the group occurred on Feb 20 8, its latitude was 6°, and its area on Feb 17, 19, and 21 was respectively 150, 900, and 1700 millionths of the sun's hemisphere On Feb 19, spectroscopic observations made at 15^h showed a mass of hydrogen to be descending into the following member of the group with the velocity of about 30 km /sec On succeeding days the group was not unusually active, so far as rather limited observations showed It may be remarked that sunspots during 1930 were both appreciably less in number and smaller than in 1929 The sunspot minimum may be expected in two or three years' time

A Faint Cluster near Betelgeux —*Circular* No 309 of the U A I Bureau contains a report from Dr Schuller, of the National Observatory, Prague, on a hitherto unknown cluster of faint stars in the position R A 5^h $40 \cdot 7^m$, N Decl 7° 21′, equinox 1855 0 Exposure of $5\frac{1}{2}$ hours showed an open cluster of stars the magnitude of which is between 16 and 18, close to the edge of Barnard's dark channel No 36 The cluster is not shown on Barnard's photographs, the Franklin Adams plates, or on those in the Atlas of selected areas None of these extend to such faint magnitudes, their limit is about $15\frac{1}{2}$ mag The distance of the cluster is roughly estimated as 30,000 light years, assuming that its brightest stars are of type *A* Its proximity to the dark lane suggests, however, that there may be some absorption of light, which would make the distance less

Search for Possible Additional Satellites of Distant Planets.—It is well known that Sir W Herschel announced the existence of six satellites of Uranus, but only four are now recognised The possibility of the existence of additional satellites both of Uranus and Neptune, has been considered by many, we learn from a *Daily Science News Bulletin* issued by Science Service of Washington, D C, that a photographic search for possible new satellites has been made by Mr W H Christie, using the 60 inch reflector and giving exposures from one to three hours. The result however, was negative in each case Mr Christie concludes that if any bodies of the kind exist, they are not brighter than mag 19 in the case of Uranus, or mag 18 5 in that of Neptune Even this negative result is of interest, and may save time, as establishing the uselessness of searching for such bodies with any smaller instrument It would seem worth while to make an attempt in the case of Pluto, success is unlikely, but would be of value in giving Pluto's mass

New Star Catalogue from Yale University —Prof F Schlesinger inaugurated a new era in star catalogues when he published, four years ago, a catalogue of stars in the zone between 50° and 55° North Declination, the places being derived from photographs with a wide angle lens that included the whole width of the zone on each plate He has now produced a similar catalogue of 7727 stars in the zone 55° to 60° The zone was covered by 72 plates, the centres of which were 20^m of R A apart, so that nearly all the stars appear on two plates They were taken between 1915 and 1917, but not measured until 1926 and 1927, this being done by Miss Ida Barney Proper motions are deduced for almost all the stars in the catalogue These will enable improved places to be obtained for the stars used as reference stars in the astrographic zones They had previously been brought up from the Astr Gesell Catalogues without proper motion in the majority of cases The probable error of the star positions in the new catalogue is given as $\pm 0 \cdot 15''$ in each co-ordinate

Research Items

Finger-prints of Twins.—A study of the finger-prints of twins has been made by Prof. H. H. Newman (*Jour. Genet.*, vol. 23, No. 3). The material consisted of the prints of 100 pairs of same sexed twins, 50 of whom were classed as identical and 50 as dizygotic or fraternal. He regards the whorl as the most primitive pattern, while some have given this place to the loop, which occurs in primitive form in anthropoids. He finds that the finger-prints of identical twins may be extraordinarily alike in pattern, although they always differ in minutiæ. The distribution of whorls, loops, and arches is the same in both types of twins and agrees with that of the general population. Radial loops and radial whorls are largely confined to the index finger. This is interpreted as a result of the early dichotomy of the limb bud, separating the thumb primordium from the rest of the fingers and tending to produce in the index finger a pattern the reverse of that in the thumb. Tented arches, which are common on forefingers, are interpreted as cases of partial asymmetry reversal. In identical twins the patterns on one or both hands resemble the hands of the other twin more strongly than do opposite hands of the same individual. The reverse is true of fraternal twins, and this difference can be used as a criterion for classifying doubtful twin pairs. If the finger patterns in human twins are compared with the scale patterns in armadillos, it is found that in both man and the armadillo parallel imaging is about twice as frequent as mirror-imaging of asymmetrical peculiarities. This leads to the conclusion that monozygotic twins in man arise in the same general way as the quadruplets which normally occur in the armadillo, that is, by a process of budding in the early embryo.

Botulism in Wild Ducks.—For several years the death of millions of wild ducks in the western States of America has been attributed to poisoning due to the alkalinity of inland waters after a spell of drought. Further investigation, according to Science Service of Washington, D.C., has shown that there are difficulties in accepting the idea of alkalinity poisoning, one reason being that in some areas where the water was highly alkaline the disease was very much less prevalent than in others where the alkalinity was small, although in general the distribution of the disease agreed with the regions of alkaline waters in the United States. Dr. E. R. Kalmbach, of the U.S. Biological Survey, has now shown that the disease is a form of botulism poisoning, and that the causative organism is different from that which affects human beings. How the organism gets into the duck's body in the first place is not known; but diseased tissues of one bird fed to another produced symptoms of the disease. One attack gives no immunity from another.

Chinese Fishes.—Papers on the fishes of China have appeared in recent numbers of two scientific magazines published in that country; one concludes Henry W. Fowler's account of "The Sharks, Rays, and related Fishes of China" (*Hong Kong Naturalist*, Nov. 1930, p. 177), and has, in addition to short diagnostic accounts of species and clear outline drawings, a list of English, Latin, and Chinese names of all the forms. The second paper, by the same author, describes a collection mainly of fresh-water fishes, obtained at Tsinan, China (*Peking Nat. Hist. Bull.*, vol. 5, Dec. 1930, p. 27). The collection contained twenty-two species, of which two gobies, belonging to the genera *Acanthogobius* and *Aboma*, are described as new. In the same magazine (p. 15) J. T. Nichols gives the synonymy of some Chinese fresh-water fishes in a paper which may be regarded as supplementary to the "provisional check-list" of the fresh-water fishes of China published as a *Bulletin* of the American Museum of Natural History in 1928.

Crustacea of the Vanderbilt Museum.—The *Bulletin of the Vanderbilt Marine Museum*, vol. 2 (Scientific Results of the Cruises of the Yachts *Eagle* and *Ara*, 1921–1928, William K. Vanderbilt commanding. Crustacea: Stomatopoda and Brachyura, by Lee Boone. Huntingdon: privately printed, 1930), is one of the scientific publications of the Vanderbilt Museum owned by Mr. William K. Vanderbilt, who made extensive collections in various parts of the world, and these collections housed in his own museum, Huntingdon, Long Island, are being described in a series of bulletins, of which the present volume is the second, the first dealing with fishes. There are several more volumes to come, which will be a great help to all zoologists. Miss Lee Boone is well known for her studies on crabs, and has dealt here with the Stomatopoda and the Brachyura in great detail. Most of the material was obtained in the West Indian region, five separate cruises in five consecutive years having been conducted by Mr. Vanderbilt, besides later work in the West Indies, supplementing the Galapagan Expedition. There are also collections from the Labrador New England region, the tropical American Pacific region, and the Mediterranean, representing terrestrial and littoral, besides deep water species. A large number of little-known forms are present, and much that is new is included with regard to their distribution, besides colour and notes on habits made on the spot by Mr. Vanderbilt. Some of the crabs are well-known northern species, such as *Portunus holsatus* and *Stenorhynchus longirostris*, but others are extremely rare. All are carefully described and well figured either by excellent photographs or by good line drawings, and the whereabouts of the type specimen (if possible) is given, with notes on general distribution and synonymy.

Culture of Entamœba.—L. R. Cleveland and E. P. Sanders (*Arch. f. Protistenk.*, 70, 1930) state that when *Entamœba histolytica* is cultivated on slants of liver infusion agar, covered with horse serum in saline (1 : 6) and a small amount of sterile rice-flour added to each tube, "the amœbæ become as numerous as blood cells are in the blood stream." A photomicrograph of a culture illustrates the abundance of the entamœbæ in such a culture. A pure line was established from a single cyst and the authors have made many studies on this pure line, for example, variation in size. They state that the size of the cysts when plotted produces a clear-cut unimodal size distribution curve, as would be expected in a pure line. The authors express the view that *Councilmania dissimilis* is an atypical *E. histolytica* "produced, for the most part, by fixation in Schaudinn's fluid heated to 60° C.", that *C. lafleuri* may very well be atypical *E. coli*, and that the genus *Councilmania* is invalid. The authors have been able to produce countless millions of cysts of *E. histolytica*, and they discuss the conditions of encystation. They have also studied the excystation and the production of the quadrinucleate amœba and the eight trophic amœbæ which result therefrom. Their work confirms that of Dobell on these stages. They report that the octonucleate cysts occasionally seen in *E. histolytica* result from the encystation of binucleate trophic amœbæ, and

they describe a process of multiple fission in which "everything occurs that occurs during encystation except that no cyst-wall is formed and motility is not lost" In a further paper Cleveland and Collier (*Amer Jour Hygiene*, **12**, 1930) give details of the improved methods of cultivation of *E histolytica*

A New Endoskeletal Organ in the Hind Leg of the Halticinæ.—In a recent note (*Zool Anzeiger*, **92**, 9/10, 1930) R J W Lever has announced that while he was examining a Halticine beetle (*Oxygona acutangula* Chevr) in Trinidad to confirm the presence of Maulik's organ in the hind femur (see NATURE, Oct 26, 1929, 668), he noticed another structure He gives a short description and six illustrations to show the form and its situation relative to other structures in the femur It seems that the importance of Mr Lever's note lies in the fact that a more comprehensive study of the structure of the femora of these extremely mobile insects is indicated It is suggested that this study may be suitably taken up by those who have the opportunity of getting a variety of fresh material Not only will such study throw light on the general question of jumping locomotion of insects, but it will in a great measure enlarge our views on relationships within the group

Banana Transport—As *Report* No 36 of the Empire Marketing Board, Claude C Wardlaw and Lawrence P M'Guire, of the Low Temperature Station, Imperial College of Tropical Agriculture, give an account of "The Behaviour and Diseases of the Banana in Storage and Transport" In view of the fact that the so called 'Panama disease' has spread to the West Indies from South America, where it has forced the abandonment of thousands of acres cultivated with the 'Gros Michel' strain of banana, it seems imperative to see whether other varieties, apparently not so susceptible to the disease, can be grown for export Many varieties are available but are not such hardy travellers or have other undesirable qualities The authors, as a result of preliminary trials on bulk storage under conditions equivalent to a ship's hold, report favourably on the 'Cavendish' variety They discuss measures for shipping bananas with a minimum of trouble from disease, and examine, from this point of view, the new practice of cutting the stalks with a sterile knife and vaselining the cut surfaces With careful handling of the fruit, this method may give still better results Packing in paper bags may lead to complications because of the difficulty in ventilation and in rapid cooling, perforated paper bags may prove useful, but the practice which is most strongly recommended to the exporter is that, when he packs in crates, the whole bunch should be pre cooled before cutting up for packing

The Outer Layers of the Earth—In the *Bull Seismolog Soc Am*, pp 41 52, 1930, Daly discusses the discontinuities revealed by seismological research on the shell structure of the earth From four different kinds of experimental evidence he deduces that the 'seismically effective' compressibility of a rock is about 20 per cent less than its compressibility as determined by the high-pressure method He notes, however, that specially designed experiments to test this idea are urgently needed The tentative conclusion, combined with seismic data, suggests that the uppermost layer of a continental block is essentially granitic down to about 30 km A shell of granodiorite or quartz-diorite is indicated below this to a depth of some 45 km The next shell is interpreted as gabbro down to 60 or 70 km Below this there is, according to Gutenberg, a drop in the velocities of the longitudinal and transverse waves which is thought to represent the change from crystalline to vitreous conditions Daly considers that vitreous basalt may extend down to 1200 km, and that there is no suggestion in the wave velocities of a shell of peridotite near the earth's surface This interpretation implies that all the exposed peridotite of the earth is a derivative from basaltic magma, a thesis difficult to support It also implies that the basaltic layer has practically no heat of radioactive origin generated within it Moreover, it should not be overlooked that the outer 30 km layer visibly contains large masses of granodiorite and more basic rocks, represented in depth by gneisses and amphibolites, the suggestion of 30 km of granite, therefore, can scarcely be readily accepted

Length of Glaciers—The work of the International Glacier Commission, which from 1894 until 1913 published an annual report on the variations in lengths of certain glaciers, was interrupted by the European War Its work has now been handed over to the Hydrological Section of the International Research Council In order to make up with arrears before the resumption of the annual report, a statistical account has now been published of the observations from 1913 to 1928 (*Rapport de la commission des glaciers, Bulletin* 14, Section d'Hydrologie Union Géodésique et Géophysique Internationale, Venice, 1930) Glaciers are grouped geographically and variations in length, where they have occurred, are given to the nearest half metre In some areas only one figure can be given for the whole period of the War The observations come from various sources, and include the French, Swiss, and Italian Alps, Sweden, and Norway A supplementary report on more scattered and less complete data is promised The general impression given by the figures is one of retreat, but there are notable exceptions The most striking is perhaps the frequent record of the advance of Norwegian glaciers since about the years 1921 and 1922 In the scanty Swedish records there is nothing comparable Alpine records show very variable conditions, but the increase of the Mont Blanc glaciers was most marked about the years 1914–20 Several of the glaciers of the Rhone basin showed an increase towards the end of this period

The Measurement of Spark-over Voltages by a Sphere-gap—In the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, vol 14, p 278, Nov 1930, T Nishi and Y Ishiguro give a helpful account of the anomalous phenomena when spark over voltages are employed for measuring the electrical pressure In high pressure engineering it is common practice to measure the crest value of alternating pressures by means of a spark gap with spherical electrodes It generally happens, however, that a few stray and erratic sparks occur at low voltages before the gap gets into the condition where a definite steady voltage always produces a spark. When the electrodes are small the preliminary sparks at low voltages do not often occur, and rarely affect ordinary testing Neither do they occur when the spark gap is very small compared with the radius of either electrode With spheres a metre in diameter, placed a metre apart, the first flash-over occurred at a voltage which was 6 per cent less than that obtained in the subsequent tests, all of which gave practically the same result When the surfaces of the electrodes were carefully cleaned by a cloth soaked in alcohol and the test repeated, the first flash occurred when the pressure was 30 per cent less than its normal value, the next occurred when the pressure

was 12 per cent under the normal, the subsequent flashes occurring at practically the same voltage Washing the surface with alcohol was very effective in lowering the pressure at which the preliminary sparks took place The curious behaviour of the sparks is attributed to the surface conditions, but the exact cause the authors were unable to determine They advise that the first few readings for a fixed spark setting should be rejected and only the steady value given

An Electrical Pendulum — A novel electrically maintained pendulum which was exhibited by the British Thomson Houston Company at the recent Exhibition of the Physical and Optical Societies is illustrated in Fig 1 A primary coil *A* carries a high frequency current generated by a valve in the box, a secondary coil *B*, forming with its condenser *C* a separately tuned circuit, is suspended from knife

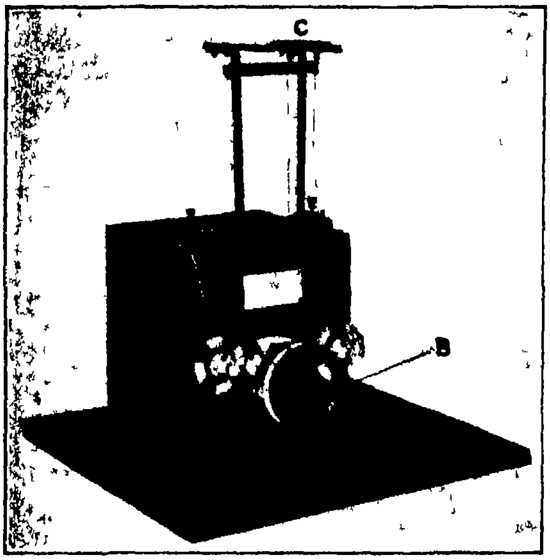

FIG 1

edges, so that when swinging to and from *A* the coupling between the two is varied periodically The electrical constants of the circuits are so chosen that the natural frequency of the secondary is higher than that of the primary when *B* is at the outward point of its swing At this position the two currents are in phase, and *B* is attracted, but as it approaches *A* an abrupt change of phase of almost 180° takes place when the coupling has increased to a certain critical amount, so that the force between the two becomes repulsive Simultaneously the frequency assumes a higher value On the outward path of *B* the converse changes occur, and so the swinging is maintained The two values of frequency are shown by the alternate lighting of two lamps connected to separate coils F_1 and F_2, which are tuned by small condensers The abrupt phase-changes are those which give rise to the well known 'double click' effect obtained with resonant circuits

Trajectories of Electrons in Valves —It is of some importance in connexion with thermionic devices to be able to find the paths of electrons within the apparatus When small quantities of gas are of no consequence, the orbits may readily be demonstrated by their optical effects in the inter electrode spaces —as, for example, has been done by E Brüche in a recent test of Størmer's theory of the aurora (*Die Naturwissenschaften*, Dec 12)—but for various reasons this method is not always permissible, and possibly not always accurate An arrangement due to Mr A J Maddock, of the British Thomson Houston Company, which was shown at the recent Exhibition of the Physical and Optical Societies, still enables the points of impact of electrons on an anode to be found in a high vacuum The anode is coated with carbon, which becomes strongly incandescent at any place where there is a concentration of the electron beams, rendering it very easy to show, for example, the effect of the grid potential in concentrating the beams to a greater or less degree The actual valve exhibited had an *M* shaped oxide coated filament, and was operated with an alternating anode potential of 700 volts peak value

Levulinic Acid and Esters —Sati and Shao-Yuan Ma in the December number of the *Journal of the American Chemical Society* describe a simple procedure for the preparation of levulinic acid from commercial glucose depending on the hydrolysis with boiling hydrochloric acid An intermediate product is oxymethylfurfural A yield of 160 gm per kilo of glucose was obtained, after distillation under 7 mm. pressure, as large glassy crystals, melting at 33° 35° From the acid, seven esters were prepared by direct esterification, they were obtained highly pure and their simple physical constants determined The work was carried out at the National Tsinghua University, Peiping West, China

Hydroxylation and Peroxide Production during Slow Combustion of Ethane —The 'chain theory' of reactions has proved very fertile in accounting for many experimental results otherwise difficult to understand Peroxide formation is believed to play an important rôle in oxidation processes by determining the length of certain reaction chains, if not as the initial stage in the process itself W A Bone with S G Hill (*Proc Roy Soc*, **129** A, 434, 1930) have re examined the slow combustion of ethane to see how far the view might still be held that the process is one of progressive hydroxylation Peroxide formation was observed concomitantly with aldehyde formation, but no evidence was found that peroxide production occurred in the initial stages of the reaction and was not a product of oxidation of the aldehyde While the hydroxylation theory was confirmed, the exact rôle of the peroxides detected must remain uncertain

Absorption of Hydrogen by Nickel —Contrary to what is observed with other metals, and also to the hypotheses of Hallwachs and Hermann, absorption of electrolytic hydrogen by nickel wire is accompanied by increase in the electrical resistance of the metal The results of an investigation into this matter by Franzini, recently described in the *Rendiconti* of the Royal Lombardy Institute of Science and Letters, show also that the temperature coefficient of the resistance is diminished as a result of the absorption of the hydrogen When the gas appears to be uniformly distributed throughout the mass of the metal, the relation between the increase of resistance and the amount of gas absorbed is probably linear, so that $\Delta r/r = cV$, and if V is expressed in volumes of hydrogen absorbed per unit volume of metal, the constant c has the value $0\ 68 \times 10^{-4}$ If the gas is non-uniformly distributed, the increase in resistance is lower than that indicated by the above equation The variation of the temperature coefficient of the resistance is also, in all probability, related linearly to the quantity of absorbed hydrogen

The Origin of Bread Wheats.

By Prof R RUGGLES GATES

AN immense amount of work has been done in recent years in crossing species of cereals and investigating the chromosome behaviour of the hybrids These crosses include not only many cultivated and wild species of wheat, rye, oats and *Ægilops*, but also intergeneric crosses between these four genera, *Triticum*, *Secale*, *Avena*, and *Ægilops* The results have thrown much light on the phylogeny of the bread wheats and their relation to other genera

In all these genera the basal haploid chromosome number is 7, and each genus except rye contains species with $2n$, $4n$, and $6n$ chromosomes It therefore seemed not unlikely that in all three genera the hexaploid condition had been independently reached, through parallel evolution, and that the bread wheats had therefore been derived from crosses between tetraploid and diploid species of wheats, forming triploid sterile hybrids in which chromosome doubling then gave rise to fertile hexaploid forms The recent work has, however, brought much evidence to show that the genera *Ægilops* and *Triticum* are very closely related as regards some of their species, and that *Ægilops cylindrica* is directly or indirectly one of the ancestors of the hexaploid bread wheats or soft wheats This latter view was first put forward by Percival in 1921 on taxonomic grounds, and has now been strongly substantiated by genetical and cytological work, confirmed by various other investigators Various workers now approximate to the view that the A and B sets (of 7 chromosomes each) in *T vulgare* came from the emmer ($4n$) wheats, while the C set has been derived from *Ægilops cylindrica* or its diploid ancestor, and a fourth (D) set from *Æ ovata*

Popova (1923) found that much natural crossing took place in Turkestan, near Tashkent, where the hills were covered with wild *Ægilops cylindrica*, *Æ squarrosa*, and *Æ crassa*, which crossed freely with wheat in the neighbouring fields *Ægilops* species showed numerous parallel variations, as indicated by the variety names, *flavescens*, *rubiginosa*, *albescens*, *ferruginea*, *brunnea*, etc, in different species The wheats also show parallel variations, awned or awnless, smooth or pubescent, ears white, red, brown, etc Also *Æ triuncialis* ($4n$), like the hard ($4n$) wheats, is resistant to rust and has a solid straw, while the other three species of Ægilops mentioned are affected by rust and have a hollow stem, like the soft ($6n$) wheats

The chromosome numbers in more than twenty species of *Ægilops* have now been counted, chiefly by Schiemann (1928) and Sorokina (1928) Among the diploid species ($2n = 14$) are *Æ squarrosa*, *Æ speltoides* and *Æ caudata*, while *Æ triuncialis*, *Æ cylindrica*, and *Æ ventricosa* are tetraploid, and *Æ crassa* and *Æ turcomanica* are hexaploid *Æ crassa* from Turkestan is, however, tetraploid Zhukovsky divided the genus into nine sections In each of these sections the chromosome number is uniform, but the sections do not coincide with chromosome numbers, as is the case in *Triticum* Asia Minor appears to be the centre of distribution of the genus, but evidently the classification of the species into sections has not yet reached a definitive state

Crosses have been made between three subspecies of *Æ triuncialis* ($n = 14$) and two of rye ($n = 7$), by Karpechenko and Sorokina (1929), using the rye as male parent The F_1 grains were mostly shrivelled and the hybrid plants resembled *Ægilops* in the majority of their characters, but the fragility of rachis in rye was dominant The 21 chromosomes in meiosis showed 5-7 bivalents, with the members of each pair end to end Occasionally a trivalent of three chromosomes arranged tandem was seen

Philipchenko (1930) made a study of the development of the ear in different species of wheat, *Ægilops*, and rye He was so impressed with the fact that in *Triticum monococcum* ($n = 7$) the development is different from that of the $4n$ and $6n$ wheats and more like rye, that he proposed to regard it as representing a separate genus, *Monococcum* The systematist's view has been that *T monococcum* (and the wild form *T ægilopoides*) stands apart from other species of *Triticum* To place it in a genus by itself seems, however, rather an extreme action Philipchenko found that the ear development in the hard ($4n$) and soft ($6n$) wheats was very similar, while the differences between *Monococcum*, *Triticum*, and *Secale* appear very early On the contrary, in *Ægilops squarrosa* ($n = 7$), *Æ ovata* ($n = 14$) and *Æ crassa* ($n = 21$) he found no important differences in ear development, from which it is concluded that polyploidy has no influence on ear development in either *Triticum* or *Ægilops*

Vavilov and Jakushkina (1925) reported on a study of *T persicum* Vav and its hybrids with other species of wheat, with *Ægilops* species, and with rye This 'Persian wheat' was obtained at Moscow in 1902 from Haage and Schmidt, who had it from a firm in Moscow in the 'nineties It was a black awned spring wheat, very resistant to mildew, and showing considerable immunity to rust Vavilov in 1916 found in Persia a series of varieties with black ears, pubescent, bearded, of the type of soft wheats, and Zhukovsky discovered in Turkestan a great diversity of varieties of this species *T persicum* is tetraploid and placed by Percival in *T dicoccum*, but Vavilov regards it as forming a link geographically between the Asiatic group, rising to *T vulgare*, and the Afro Mediterranean tetraploid wheats It produces a dirty brown flour without the yellowness of the *durum* wheats, the bread being more like that from rye in appearance but having a peculiar flavour Although tetraploid, it shows a number of characters belonging to the soft wheats It produces fertile hybrids with other $4n$ wheats, but markedly sterile hybrids with $6n$ wheats, and still more with *T monococcum*, as well as in crosses with *Ægilops triuncialis* and rye

In 1914 Tschermak (1929) found in the Greek Theatre at Palermo, and afterwards as a weed in the Appian Way at Rome, the wild *T villosum* or *Secale villosum*, which Bleier showed to be diploid It was used as male in crosses with *T spelta* ($n = 21$), *T durum* ($n = 14$), and especially *T turgidum* ($n = 14$) The latter hybrids were intermediate and mostly sterile A few stronger F_2 plants were obtained from unprotected seeds The strain was more fertile in F_3 and F_4, but showed no segregation This is probably an amphidiploid with $(14 + 7) \times 2 = 42$ chromosomes, but the number has not been counted The first observed case of this kind in wheats will be referred to later

Some of the wheat rye hybrids which have been investigated throw important light on the relationship of the cereals and the general manner in which the hexaploid wheats may have arisen W P. Thompson (1926) studied the cytology of a wheat-rye hybrid The cross was easily made with certain varieties of *T vulgare*, producing a very vigorous F_1, which was not quite sterile Its chromosomes numbered $21 + 7 = 28$ The heterotypic metaphase in meiosis was very irregular There were often one or

two, but rarely three, bivalents. Most of the chromosomes divided in the second division, but many lagging chromosomes formed extra nuclei It was concluded that probably none of the rye chromosomes are homologous with those of the wheats

The experiments on rye-wheat hybrids (*S cereale* × *T vulgare*) which Meister has been making for a number of years at the Saratov station on the Volga have yielded important results Among the practical results has been the production of wheats with valuable rye characters, such as early ripening and winter hardiness Meister also obtained a constant intermediate fertile hybrid in F_3 It has since maintained its type, and the F_8 plants recently examined by Levitsky and Benetzkaia (1929) showed 56 chromosomes It is thus an amphidiploid with $(7+21)\times 2$ chromosomes Meister and others have shown that the F_1 probably do not pollinate themselves, hence there is probably apogamous development of certain F_1 ovules with the somatic chromosome number, this number being doubled in the first mitosis of the egg cell It was found that in the embryo sac of the F_1 the chromosomes do not conjugate but about 28 pass to each pole, so that eggs with 28 chromosomes must be formed The meiosis in the pollen mother cells of the amphidiploid shows 28 bivalent chromosomes, but notwithstanding this balanced condition there are many irregularities from lagging chromosomes and disintegration of certain chromosomes

Perhaps the most striking cases of an amphidiploid hybrid, however, and the first of their kind, were obtained by Tschermak and Bleier (1926) From the crosses *Ægilops ovata* × *T dicoccoides* and *Æ ovata* × *T durum*, constant octoploid forms were derived by chromosome doubling in the F_2, producing plants with normal chromosome pairing in later generations The frequency with which such forms can arise from *Ægilops Triticum* crosses strengthens the view that the hexaploid wheats actually did arise from such a cross between tetraploid (emmer) wheats and a diploid species of *Ægilops* In all the hybrids between *Æ cylindrica* and the 6*n* wheats there are constantly seven close pairs of meiotic chromosomes, from which Percival concludes (1930) that seven of the chromosomes of these wheats have been derived from the tetraploid *Æ cylindrica*

Extensive studies of the chromosome behaviour in many hybrids between *Triticum* and *Ægilops* have also been made by Sax (1924), Jenkins (1929), Aase (1930), Longley and Sands (1930), Bleier (1930), and others Bleier has recently concluded that pairing of the chromosomes in these hybrids depends partly on the varieties chosen and partly on the environment He is less sanguine than some others that the phenomena of pairing will furnish a sufficient key to chromosome homologies in the various species Sax supported the view that the hexaploid wheats came from crosses between emmer and *Ægilops*, based partly on chromosome pairing and partly on the fact that the characters which distinguish the hexaploid from the emmer wheats are all found in *Æ ovata* and *Æ cylindrica*

Another interesting line of evidence of relationships has been obtained by Kagawa (1928, 1929) The volume of the pollen grains in the diploid *Æ speltoides* was compared with that of four tetraploid species In two of the latter (*Æ squarrosa* and *Æ triuncialis*) the volume was approximately double, suggesting that they might be autotetraploids, while in two others (*Æ ovata* and *Æ cylindrica*) it was not In *Æ cylindrica* × *T dicoccum* during meiosis there were sometimes 1-4 end to end pairs, and in *Æ ovata* × *T polonicum* 1 or 2 such pairs Occasionally the chromosomes in such a pair were of unequal size But Kagawa's most interesting work was in carefully comparing the types of the somatic chromosomes in various species of *Triticum*, *Ægilops*, and *Hordeum*. The chromosome pairs in a species frequently show constant differences both in length and in the position of constrictions or spindle fibre attachments By these methods it was found that *T monococcum* has three long pairs of chromosomes (two of which have a single constriction and the third two constrictions), the other four pairs being progressively shorter, with characteristically placed constrictions *T polonicum* had four similar pairs and others that were different By such comparisons of the chromosome sets in different species it was concluded that in *T polonicum*, *T dicoccum*, and *T vulgare* most of the chromosome types were represented by a single pair in each cell, and similarly that the tetraploid *Ægilops cylindrica* could not have arisen from the doubling of the chromosomes in *Æ speltoides* While this work is doubtless subject to some revision, it seems to show that autopolyploidy has seldom occurred in these genera, but that higher chromosome numbers have usually appeared following crossing

Watkins, in a series of papers (1928), has made an intensive study of crosses between *T turgidum* (4*n*) and *T vulgare* (6*n*) Among his conclusions may be mentioned that the differences between the conspicuous hexaploid types *vulgare*, speltoid, and *spelta* were due to three factors, *k*, *K*, and *Ks*, which were either multiple allelomorphs producing different degrees of keeled glumes (the most conspicuous difference between *turgidum* and *vulgare*) from the round-glumed *vulgare*, or more probably three groups of completely linked factors This view is supported by the fact that these three factors or factor groups all show the same linkage value with the factor for awns The factor *Ks* in *dicoccum* is moreover identified with *Ks* in *spelta*, while similar factors *K'K'* are believed to be carried by the extra chromosome sets of *spelta* Thus *turgidum* and *durum* are given the formula *KK*, and *vulgare* (*kk*)*K'K'* By study of the cytology of reciprocal back-crosses of the F_1 *turgidum-vulgare* hybrids with both parents, it was found that 14 *turgidum* chromosomes pair with 14 of the *vulgare* The conclusion was reached that the 14 chromosome pollen from the back crosses carries mainly *turgidum* characters, while the pollen with 17 21 chromosomes carries mainly *vulgare* characters The results did not disclose many factor differences between the 14 *turgidum* chromosomes and the 14 *vulgare* chromosomes with which they pair, leading to the suggestion that a simple polyploid relationship exists between these two species

Huskins (1930) finds irregularity in the meiosis of *T spelta* and *T vulgare*, and on this basis extends Winge's hypothesis of the origin of speltoid wheats through irregular distribution of certain chromosome pairs in the reduction division Thompson and Robertson (1930) have also found in hybrids *vulgare* × *spelta* and *vulgare* × *compactum* a considerable proportion of pollen mother cells with one or a few lagging univalent chromosomes, such cells being much less frequent in the pure species Similar results are obtained among the tetraploid wheats Such phenomena indicate complete homology between chromosomes which fail to pair Thompson has also shown that in various hybrids between species with different chromosome numbers there is disharmony between the embryo and the endosperm with its additional set of maternal chromosomes, thus leading to differences in reciprocal crosses

Percival (1930) has studied 33 hybrids between four tetraploid *Ægilops* species (*ovata*, *cylindrica*, *triuncialis*, and *ventricosa*) and various 2*n*, 4*n*, and 6*n* wheats, as well as hybrids between the four *Ægilops* species themselves In hybrids between *Ægilops* and

wheats he finds a certain number of bivalent chromosomes, which are all telosynaptic or end-to-end In crosses between *Æ cylindrica* and the 6n wheats, however, he always finds constantly 7 parasyndetic bivalents formed from the end to end arrangement by the chromosomes swinging round to lie side by side This, as well as the characters of *cylindrica*, point to the presence of 7 *cylindrica* chromosomes in the hexaploid wheats Hence telosynaptic pairing is regarded as evidence of a less complete homology or a more distant relationship between the members of a pair than is parasynapsis

The hybrid *Æ cylindrica* × *Æ ventricosa* is sterile, but its characters show remarkable resemblance to those of *T spelta* In meiosis there are 5 7 bivalent chromosomes, chiefly parasyndetic but some telosyndetic, indicating that one set of chromosomes are homologous in the two species The two types of pairing are also described in various species hybrids by Aase Percival also considers *T dicoccoides* (4n) to be an autopolyploid of *T ægilopoides*, and concludes that the emmer wheats are probably autopolyploids from the Einkorn wheats These conclusions, however, require further evidence

Nishiyama (1930) has described similar conditions in crosses of *Avena* species *A fatua* ($n = 21$) × *A sativa* ($n = 21$) gives a hybrid with 21 parasyndetic bivalents in meiosis, leading Percival to conclude that cultivated oats was derived from the wild *fatua*, while *A barbata* ($n = 7$) × *A sterilis* gives telosyndetic pairs

Watkins (1930) has just published an extensive critique of all the work on wheat (*Jour Genet*, vol 23, No 2), in which he points out difficulties with the theory of cumulative factors for size inheritance as applied to wheats, and shows that the chromosome behaviour of hybrid cereals requires further study While the details therefore remain uncertain, there is evidence for concluding that the origin of the hexaploid wheats has involved interspecific and intergeneric crossing, with allopolyploidy and probably also autopolyploidy, combined with the occurrence of numerous parallel unit mutations

A recent study of the related grass genus *Agropyron* by Peto (*Can Jour Research*, vol 3, p 428) again shows 2n, 4n, and 6n species ($n = 7$), with evidence of natural hybridisation between species having the same or different chromosome numbers This condition is probably very similar to that under which the wheats evolved, except that the hexaploid wheats may have arisen entirely under conditions of cultivation

Upper Atmosphere over India

THE inexpensive type of apparatus for obtaining readings of pressure and temperature at great heights in the upper atmosphere which was invented by the late W H Dines in 1907 has been employed in many countries It has been used with one minor modification at Agra (*Gerlands Beiträge zur Geophysik*, vol 25 (1930), pp 266-278, by G Chatterjee and N K Sur)

In Dines's apparatus the graph of each record, temperature and pressure being the ordinates and abscissæ, is traced by a sharp non rusting steel point on a silvered copper plate little larger than a postage stamp, the motion due to variations of pressure being provided by a small aneroid box and those due to change of temperature by the expansion and contraction of a rod of German silver Difficulty was experienced at Agra in obtaining a continuous scratch on the recording plate, especially when the sounding balloon carried the instrument into the stratosphere, which is there reached at a higher level than over the British Isles, and is in consequence much colder It was found that the substitution of a deposit of colloidal graphite on glass, for the silver surface, overcame this tendency, and allowed very sharp records to be obtained with only slight pen pressure

Owing to the rapidity with which rubber balloons perish in India, Vulpro tissue balloons (see NATURE, vol 124, p 793, 1929) were substituted for them in 1926, since then balloons have often risen as high as the stratosphere, and the number of observations obtained permits of a fairly detailed account of the seasonal changes of temperature between the level of the ground and a height of 20 km

The monsoon season in India (June to September) was found to be decidedly the hottest up to nearly 14 km, and at this season the lapse rate of temperature is higher between 12 km and 15 km than lower down, a state of affairs believed to be due to a difference of origin of the air above and below the average level of the cirrus clouds (12 km) The base of the stratosphere (the 'tropo pause') appears to be found at an average height of about 16 km or 17 km at all seasons, but its mean temperature has an annual variation with a minimum of 192° A at about the end of the rainy season The lowest value obtained at Agra so far is 181° A at a height of 16 5 km on Oct 4, 1928, which equals the lowest yet found —at a slightly higher level—over Batavia in 1923, which for long was regarded as the lowest atmospheric temperature observed anywhere in the world

'Sea Trout' or 'Bull Trout'?

THE brown trout and the sea trout, possibly members of one plastic species, have been the cause of much controversy Living under widely varying conditions and possessing very different habits, they show differences in appearance which have given ground for much 'splitting' in the past Furthermore, because they have come much under the eye of observant anglers, many without the knowledge of a trained biologist, who himself is always in difficulties when deciding where a 'species' ends and where it begins, it is natural that the popular accounts of these fish have shown very divergent opinions That they are specifically indistinguishable is perhaps the general consensus of opinion at the present day, but there has still been a certain amount of indecision as to where exactly to place the so called 'bull trout' of the Tweed and other rivers

A critical examination of the sea trout of the river Tweed * comes therefore as a welcome addition to our knowledge of this interesting species Mr G H Nall, of the Scottish Fishery Board, has shown that the sea trout of the Tweed exhibit a marked difference from those of many other Scottish rivers in the great rapidity of their growth during sea life As an example, the average weight of a fish in its third sea summer for the Tweed is 7 lb 7 oz, as against 3 lb 5 oz for the Howmore, 2 lb 13 oz for the Ailort, 2 lb 6 oz for the Forth, and 2 lb 3 oz for the Spey Similarly, for fish in their fifth sea summer the average weight for the Tweed is 12¼ lb as against the highest of 6 lb 7 oz for the Howmore amongst the above four rivers

* Fisheries, Scotland, Salmon Fish, 1929, No 5 Sea Trout of the River Tweed By G Herbert Nall (London H M Stationery Office, 1930) 3s 6d net

Coincident with this rapidity of growth is a short span of life, and consequently few spawning operations. There is an indication that the Tweed sea trout travel very far afield during their sojourn in the sea, which may account for their great growth; marked fish have been recovered from the South Esk, from off the Norfolk coast, off the Dutch coast, and off the Jutland coast of Denmark, though the numbers of recaptures from each place so far only amount to single figures.

Owing to the divergent characters of the spawning grounds in a river with so large a number of tributaries as the Tweed, and since the fish may stay close to their home neighbourhood or range very far afield during their sea life, it is possible that various types of fish may become apparent. As a result of his examinations, Mr. Nall comes to the opinion that "there is no evidence to justify the old belief that the Tweed has two or more distinct races of sea trout". He considers, however, that the sea trout of this river undoubtedly do form a well marked local race, similar to that found in Northumbrian rivers to the south; but that this does not warrant them being considered a different species as the name *Salmo eriox* would imply, nor is the name 'bull trout' applicable, since it is a term applied in different districts to very different types of fish and is therefore misleading.

F. S. R.

University and Educational Intelligence

BIRMINGHAM.—In his annual report to the Court of Governors, the Vice-Chancellor, Sir Charles Grant Robertson, announces that during the past session the upward tendency in numbers of students at the University was maintained. The number of new entries for the present session, however, shows a slight falling off. Sir Charles Robertson is of opinion that while the depression of trade may have little effect on the number of students entering the University, it has marked and far-reaching effects on the student who has, in consequence, perhaps £10 a year less to spend on the amenities which mean so much in a university education, as distinguished from mere university instruction. Considering that 49 per cent of the students hold scholarships or have assistance in meeting the expenses of their university careers, and that about 53 per cent began their education in elementary schools, it will be understood that such a curtailment of spending power affects many. "Hence particularly in hard times, it is wise as far as possible to remember that expenditure on Library, Refectories, and Halls of Residence have their educational values. . . . In *principle*, the application of university income to promote activities or create opportunities, so as to secure that a university education, and not merely university instruction, is provided, is as justifiable as the allocation of that income to scholarships, exhibitions, lecture rooms, or apparatus." Reference is made to the increase in the Government grant to the University, and it is suggested that about half of this should go to increase the salaries of professors. The voluntary medical examination of intending women students has proved so satisfactory that all the women avail themselves of it, and it is suggested that a similar opportunity should be given to the men students.

Prof. S. W. J. Smith has been appointed to represent the University at the Clerk Maxwell Centenary at Cambridge in October.

CAMBRIDGE.—The Appointments Committee of the Faculty of Biology 'A' has appointed Mr. W. B. R. King, of Magdalene College, to be University lecturer in geology. The Faculty Board of Biology 'A' has appointed Dr. H. Godwin, Mr. J. Gray, of King's College, Dr. H. H. Thomas, and Dr. F. F. Blackman, of St. John's College, to be members of the Botanic Gardens Syndicate.

LONDON.—The London County Council has informed the University that the Council's block maintenance grant to the University in each of the four academic years, 1931–32 to 1934–35, will be £125,000. This is an increase of £20,000 on the Council's grant for the current year and of £44,000 on that for 1929–30.

ST. ANDREWS.—Dr. D. F. Cappell, lecturer in pathological histology in the University of Glasgow, has been appointed professor of pathology in the University of St. Andrews in succession to Prof. Sutherland, who retired at the end of last academical year. Dr. Cappell graduated in the University of Glasgow as M.B., Ch.B., in 1921, and has since been engaged in teaching and research work in pathology in the University of Glasgow.

WALES.—Five fellowships, each of the annual value of £200 and tenable for two years, are being offered to graduates of the University of Wales. Applications should be sent, by, at latest, June 1, to the Registrar, University Registry, Cathays Park, Cardiff.

AN election to Beit fellowships for scientific research will take place in July. Only candidates less than twenty-five years of age are eligible. The latest date for the receipt of applications (which should be sent to the Rector, Imperial College of Science, South Kensington, S.W.7) is April 14.

THE following scholarships are being offered by King's College of Household and Social Science: a 'Carl Meyer', value £80 a year, tenable for three years, and a 'Minor College', value £40 a year, tenable for three years. Particulars can be had from the Secretary of the College, Campden Hill Road, W.8.

TATE and Morgan scholarships for the session 1931–1932 are being offered by Battersea Polytechnic, and the examinations for them will be held on June 9 and following days. The scholarships will be tenable for two or three years. The yearly value of each will be from £20 to £30, with free tuition. Particulars are obtainable from the Principal. Applications must be made, at the latest, by April 18.

NOTICE is given by the Faraday House Electrical Engineering College that examinations for the Faraday and Maxwell scholarships will be held on Mar. 31, April 1 and 2. The annual value of the former scholarship is 80 guineas and that of the latter 60 guineas. The scholarships are tenable for two years in the college and one year in works. Particulars are obtainable from the Registrar of the College, 62 Southampton Row, W.C.1.

THE Board of Education is again prepared to receive applications for Full Time Studentships from teachers desiring financial assistance in order to attend approved full time courses of advanced study at universities or other institutions at home or abroad. The amount of grant is fixed by the Board and cannot exceed £100 for an academic year. The course proposed, if academic, should be of post-graduate type, but the Board is prepared to consider also proposals involving travel or the practical study of industrial conditions connected with the teaching of technical subjects. Applications for the year 1931–32 should be made before May 31. Further information and application forms can be obtained from the Board of Education, Whitehall, London, S.W.1.

Birthdays and Research Centres

Feb 28, 1858.—Mr J SWINBURNE, F R S, past president of the Institution of Electrical Engineers and of the Faraday Society

My present investigations are on the behaviour of the watch balance and the photography in relief of micro scopic objects

Further research is little more than intellectual exercise, since *humanity is too ignorant to utilise it* well because natural science is immeasurably ahead of other branches of knowledge Human happiness involves first a science of sociology, and this is scarcely begun People do not know it exists, and think important questions can be settled without study On social questions people are not merely ignorant, they are saturated with wrong ideas and prejudices and are full of negative knowledge The history of early Greece is vague, but, we may take it, applied sociology, in the form of modern governments, is more than two thousand seven hundred years behind ap plied natural science

Mar 2, 1870—SIR FREDERICK W KEEBLE, C B E, F R S, controller of agricultural research, Imperial Chemical Industries, Ltd, formerly Sherardian professor of botany in the University of Oxford

The investigations on which I am now engaged are twofold in object The chief series, which is being carried out in co operation with the agricultural research staff of Imperial Chemical Industries, Ltd, is concerned with the improvement of arable and grass land and the more profitable utilisation of pastures and meadows, a subject which, apart from its scientific interest, has a far reaching importance in relation to the welfare of Great Britain and the Dominions of the Empire

The second subject is the chemical and other means whereby the plant body is integrated so that, made up of similar parts having no apparent nervous ties, the organism nevertheless behaves continuously as a whole, co ordinating the activities of the several parts in what appears to be the general interest of the plant itself

Mar 7, 1869—Prof ERNST COHEN, For Mem R S, professor of physical chemistry, University of Utrecht

The investigations I have carried out during these last few years with my collaborators, Drs Moesveld, Helderman, Bruins, Douwes Dekker, van Dobben burgh, Kooy, and Bredée, have shown that the physical and physico-chemical constants of *chemically pure* solid substances hitherto recognised are values which refer very often, if not always, to metastable mixtures, which contain two or more modifications of those substances in unknown proportions These substances are *physically impure* As a consequence of this fact, errors of 5, 10, 100, 200 and more per cent in the physical and physico chemical constants of such substances may occur We are now studying methods whereby the *chemically* and *physically* pure stable and metastable modifications may be prepared and their physical and physico-chemical properties ascertained

Societies and Academies.

LONDON

Royal Society, Feb 19—**A J Allmand and L J Burrage** The discontinuous nature of the process of sorption of gases and vapours by porous solids A summary is given of results obtained either at low pressures or by a new 'retentivity' technique, indicating the presence of discontinuities in the adsorption isothermals and isosteres of vapours on charcoal The technique is described of a simple static method for the determination of adsorption isothermals, which permits of the detailed examination of a limited pressure range being rapidly carried out Breaks in the isothermals were found in all cases Measurements with silica gel and with benzene, carbon tetrachloride, and water also showed discontinuities, rudimentary or slight in the first two cases, but very pronounced with water A view of the mechanism of the adsorption process is outlined which has features in common with Polanyi's modified theory and with recent suggestions of Semenoff Distinctions are made between the behaviour (*a*) of activated charcoal and of silica gel and (*b*) of water (molecules natural dipoles) and of carbon tetrachloride (molecules without dipole moment)—**L N G Filon and F C Harris** The photo elastic dispersion of vitreous silica Double refraction was measured for a series of well determined wave lengths, the load on the specimen remaining unaltered throughout each set of observations The results show (1) that the law of photo elastic dispersion in silica varies slightly with the load applied, so that the usual assumption that the double refraction is proportional to the stress cannot in this case be exactly true, (2) that the curve of photo elastic dispersion shows marked and highly localised oscillations, (3) that these oscillations are very probably due to some natural periods of the molecules—**C G Darwin** Examples of the uncertainty principle Observations with electrometers and magneto meters conform to the uncertainty principle of Heisenberg—**G B Deodhar** Some investigations in Röntgen spectra (1) The $K\alpha$ and $K\beta$ groups of the elements silicon, phosphorus, sulphur and chlorine have been studied—(2) A large number of sulphur compounds have been examined, and it is found that considerable changes in the relative intensities of the β_1 and β_x lines take place from substance to substance—(3) The fine structure of the K-edge of silica is recorded and measured by using quartz as the analysing and absorbing substance The observed fine structure may result from the ejected K-electron stopping in one of the possible virtual electron orbits in the SiO_2 molecule, as has been suggested in the investigation of the spectra of sulphur compounds

Physical Society, Jan 16—**T L Ibbs** The influence of low temperatures on the thermal diffusion effect Measurements of thermal diffusion on the following gas mixtures at temperatures between 15° C and −190° C are described helium neon, hydrogen-neon, helium argon, neon argon, helium nitrogen There is a general tendency for k_t to decrease at low temperatures It is found, however, that for the pairs of gases helium neon and hydrogen-neon the change in k_t between 15° C and −190° C is small Chapman's theory is used to deduce approximate values of the laws of repulsive force operating between unlike molecules during collisions At low temperatures, molecules tend to become 'softer' and their behaviour is less like that of rigid elastic spheres The 'hardest' molecules appear to show the smallest variation in k_t The influence of helium in this respect on the value of k_t for a mixture is clearly shown

Linnean Society, Feb 19 —**V S Summerhayes** The angiospermic flora of the Seychelles Archipelago The angiosperms of the Seychelles number altogether 479 species, of which, after deducting 247 weeds and escapes from cultivation, 232 remain as indigenous These include 7 marine and 54 littoral species, the remaining 171 being inland species Neither the marine nor the littoral species afford much indication of the origin of the flora as a whole The fact that the dominant forest trees are mostly of Asiatic affinity strengthens the indications that the flora of the Archipelago is chiefly Asiatic in origin The total of 171 inland indigenous species is very small, considering the area of the group (160 square miles) This is probably due to the intense competition between the species of an originally much larger flora, consequent on the gradual reduction in area of a land mass of 20,000 square miles to the present islands It is suggested that this took place relatively recently, since there is little evidence of specific segregation as between the floras of different islands or island groups

DUBLIN

Royal Dublin Society, Jan 27 —**A R G Atkins** and **H H Poole** Photoelectric measurements of illumination in relation to plant distribution (4) Changes in the colour composition of daylight in the open and in shaded situations Campbell's thin film cæsium on silver vacuum cell was used with various coloured filters, the colour transmission curves of which were obtained by means of a monochromatic illuminator, and a Moll vacuum thermopile The photoelectric current was measured in the field by J H J Poole's neon lamp method The relative intensities of the various colours in shaded sites were compared with those found for the diffuse light in the open The measurements clearly show the great relative abundance of green and of deep red light in woods, and the scarcity of blue light This change of spectral distribution seems to follow closely the colour transmission curve for chlorophyll Measurements were also made of the relative colour intensities of sunlight and diffuse daylight in the open, under various conditions

PARIS

Academy of Sciences, Dec 29 —**E Goursat** Some integrable forms of a Monge equation —**H Deslandres** Simple relations of molecular spectra with the structure of the molecule Since 1919 the author has pointed out that the frequency $d_1 = 1062\ 5$ is a fundamental one in molecular and atomic spectra In the present paper new data are given in confirmation, including some data based on the Raman spectrum —**L Blaringhem** and **M Chopin** The regularity of the surface tensions of the fresh latex of *Euphorbia Lathyris* In an earlier communication, a description was given of an instrument capable of measuring the surface tension of very small quantities of a colloidal liquid The application of this apparatus to the measurement of the surface tension of the latex of *Euphorbia Lathyris* shows that the surface tensions of this latex are unexpectedly constant and might serve to characterise the type Latices from other plants gave different figures —**Gabriel Bertrand** and **Mme Y Beauzemont** The proportion of zinc in the liver of the rat in course of growth. The percentage of zinc is highest in the liver of the new born rat, gradually falling to about one-third in the adult rat —**Ch Achard** and **M Piettre** The mucin of articular fluids Mucin from the synovial fluid is characterised by its high viscosity and percentage of sulphur (0 7 per cent) —**C de la Vallée Poussin** The conformal representation of multiply connex-plane areas —**C Gutton** and **G Beauvais** The reflection of electromagnetic waves. A repetition of Garbasso's experiment on the reflection of Hertzian waves by resonators with very short wave-lengths (17 cm) —**E Mathias** The confusion between the effects of lightning proper with those of fulminating material The author distinguishes between the effects of lightning, a current of electricity, and those of the explosive compound (a chemical substance) produced by the flash —Henri Lagatu was elected *correspondant* for the Section of Rural Economy in succession to the late M Godlewski —**Léon Pomey** A problem put by Chasles (The generalisation of Pascal's theorem)—**V Chepeleff** and **M Lavrentieff** Conformal representation —**Henri Milloux** A general property of integral functions of infinite order —**A Buhl** Dynamical considerations connected with wave geometry —**Kao Lou** A map of the sky in the Paris National Library This has been regarded as a Chinese map , but the author gives reasons against this view The date of the map is probably A D 1711 —**J Ph Lagrula** The homographic formulæ of verticity and their direct development —**Th V Jonescu** and **C Mihul** The dielectric constant and conductivity of ionised gases —**Jean Louis Destouches** The theoretical interpretation of the Davis Barnes effect This explanation is based on a formula given by Stireckelberg and Morse —**J J Trillat** The phenomena of transformations of the nitrocellulose network Their generality in cellulose compounds —**J Peltier** Research on the flaws and vibrations of ferro-magnetic test pieces A modification of the method previously described, in which an amplifying arrangement and loud-speaker replace the galvanometer —**Ch Dévé** A projector of alignment —**George F Jaubert** A reinforced pseudo liquid colloidal diaphragm, intended for the electrolytic decomposition of water The diaphragm is formed of metal gauze, with a colloid such as magnesium and calcium silicate (colloidal asbestos) deposited from suspension in a caustic potash solution by the action of an electric current The layer thus formed offers no resistance to the passage of the current or the electrolyte, but is quite impermeable to the gases (hydrogen and oxygen) With cells taking up to 5000 amperes the hydrogen obtained is 100 per cent pure, but the oxygen contains about 0 5 per cent hydrogen —**La Goldstein** Atoms of recoil in gaseous media —**R Charonnat** Researches on the rôle of water in salts the *aquo* combinations of the ruthenium IV ammines —**G Darzens** and **A Lévy** Dimethylallylbenzylacetic acid and isopropylbenzyl valerolactone —**L S Glichitch** A new monocyclic sesquiterpene alcohol, fokienol This new alcohol has been obtained from the essential oil of Pe-Mou, *Fokienia Hodginsii*, and was obtained pure through its formate Dehydrated by the method of L Ruzicka and J Meyer, fokienol gives 1 6 dimethyl 4-isopropyl naphthalene (cadaline) —**J F Durand** and **Lai-Wai Hsun** The action of the hexahalogen benzenes on mixed organo magnesium compounds Hexamethylbenzene was obtained by the action of methylmagnesium iodide in large excess upon hexabrombenzene hexaphenylbenzene was prepared similarly from phenylmagnesium bromide —**P Fallot** and **M Blumenthal** The tectonic interpretation of the north west of the Spanish Rif —**P Rougerie** The daily variation of the earth currents recorded at the Parc Saint-Maur Observatory —**F. Bordas** The rain of mud of November 27, 1930 Analyses prove the similarity of composition between the dusts collected at Paris and in the south of France The origin of the dust is doubtful, but northern Africa appears probable —**Jean Piveteau** : The distribution of Teleost fishes in large natural groups —**André**

Meunier: Researches on the variations in the coloration of plants in the course of drying The arbutoside arbutine is the chromogen of *Orobus niger* —Emile F. Terroine, R Bonnet, P Danmanville, and Mlle. G Mourot The excretion of creative substances as a function of the endogenous nitrogenous expenditure —P Chevey · An attempt to apply the method of observation of the scales to the study of the growth of the fish in the Grand Lac du Cambodge and of Tonlé Sap —Jean Loiseleur The properties of the biochemical constituents, especially proteins, in anhydrous solutions —A Blanchetière The fermentative hydrolysis of gelatine in its relations with the formation of the diacipiperazines —P Delanoë The rôle of the porcupine as a reservoir of the virus of the Moroccan spirochæte, *Sp hispanicum* var *morocanum*

Official Publications Received.

BRITISH

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 69, No. 409, January Pp 121 212+xxxii (London E and F N Spon, Ltd) 10s 6d

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1929-30 Pp. 72 (London The Crown Agents for the Colonies) 5s

Journal of the Royal Microscopical Society Series 3, Vol 50, Part 4, December Pp xvi+387 527 (London) 10s net.

Amgueddfa Genedlaethol Cymru National Museum of Wales Twenty third Annual Report, 1929-30, presented by the Council to the Court of Governors on the 24th October 1930 Pp. 39+6 plates (Cardiff)

Publications of the Dominion Astrophysical Observatory, Victoria B C Vol 4, No 16 The Orbit of H D 32990 (103 Tauri, Boss 1216) By S N Hill. Pp 261 269 25 cents Vol 4, No 17 The Wolf Rayet Stars. By C S Beals Pp 271 302+plates 10-11 25 cents Vol 4, No 18 The Orbit of Boss 3180 By W E Harper Pp 303 307 25 cents (Ottawa F A Acland)

The Presidential Address on The Influence of Physical Research on the Development of Wireless, by Dr W H Eccles, given before the Institute of Physics on May 27, 1930 Pp 18 (London Institute of Physics) 1s.

FOREIGN

Comptes rendus des travaux du Laboratoire Carlsberg 18me Vol No 6 Pp 72+10 planches (Copenhague H Hagerup) 5 kr

Smithsonian Miscellaneous Collections. Vol 82 No 13 A Note on the Skeletons of two Alaskan Porpoises. By Gerrit S Miller Jr (Publication 3107) Pp 2+1 plate Vol 82, No 14 The Supposed Occurrence of an Asiatic Goat Antelope in the Pleistocene of Colorado By Gerrit S Miller, Jr (Publication 3108) Pp 2+2 plates Vol 82, No 15 Three small Collections of Mammals from Hispaniola By Gerrit S Miller, Jr (Publication 3109) Pp. 10+2 plates. (Washington, D C Government Printing Office)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1930 (Publication 3078) Pp vii+147 (Washington, D C Government Printing Office)

CATALOGUES

Selected Works on Natural History, including Periodicals and Publications of the Learned Societies and an Important Collection of Linnaeans (New Series, No 24) Pp. 60. (London Wheldon and Wesley, Ltd)

Botany, Gardening and Agriculture. (Short List B 7) Pp. 10 (London Francis Edwards, Ltd)

Catalogue of Books on Botany, Ecology, Entomology, Forestry, Natural History, Ornithology, Zoology, Invertebrate and Vertebrate. Pp. 28. (London W and G Foyle, Ltd)

The Nickel Bulletin Vol 4, No. 2, February Pp 33-64 (London The Mond Nickel Co., Ltd.)

Diary of Societies

FRIDAY, FEBRUARY 27

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre) (at Electricity Offices, Swansea), at 6.—B Leggett The Medical and Surgical Applications of Electricity

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne), at 6.—Dr J Montgomerie Some Notes on Motor Engine Seatings.

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 6 30 —A Lakeman The Construction of an American Factory

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (jointly with Institution of Rubber Industry) (at Milton Hall, Manchester), at 7.—G. F Thompson and E V Bratby Colours used in the Rubber Industry.

WEST CUMBERLAND SOCIETY OF CHEMISTS (at Workington), at 7 —Dr. G B Slottman Fuel Economy in Iron and Steel

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College), at 7 15.—A Watson The Work of the Building Research Station

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7 30 — J H Strong Some Modern Tendencies in Cotton Manufacturing

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon Tyne Section) (at Armstrong College, Newcastle upon Tyne), at 7 30 —Dr B Moore Fused Silica in Industry

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —W A Tookey Oil Engines for the Maritime Fishing Industry

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8 —Dr P Manson Bahr The Epidemiology of Human Trypanosomiasis

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir Francis Younghusband: The Re-Birth of India.

ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—H Sutton Aircraft Light Alloys

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Thomas Café, Swansea) —Dr A J Amour The Pathology of some Industrial Poisons

INSTITUTION OF ELECTRICAL ENGINEERS (at Armstrong College, Newcastle on Tyne) —F J Baldwin Overhead Line Work—More Especially in Connexion with the Grid (Students Lecture).

SATURDAY, FEBRUARY 28

MATHEMATICAL ASSOCIATION (at Bedford College), at 3 —W J Dobbs The Correlation of Trigonometry and Geometry in Elementary School Mathematics

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —J Stephens A Poetry Recital

INSTITUTE OF BRITISH FOUNDRYMEN (East Midlands Branch) (at Technical College Derby), at 6 —F C Edwards Testing Castings

INSTITUTE OF BRITISH FOUNDRYMEN (Newcastle-on Tyne and District Branch) (at Neville Hall, Newcastle on Tyne), at 6 15 —C E Pearson The Deterioration of Grey Cast Iron on Repeated or Prolonged Heating

INSTITUTE OF BRITISH FOUNDRYMEN (Wales and Monmouth Branch) (at Merchant Venturers Technical College, Bristol), at 6 30 —W Jackson Interesting Moulding Jobs

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College Hull), at 7 15 —Capt. A E Butterfield Development of Unattended Navigation Lights

MONDAY, MARCH 2

ROYAL SOCIETY, EDINBURGH at 4 30 —Dr Baini Prashad Some Noteworthy Examples of Parallel Evolution in the Molluscan Faunas of South Eastern Asia and South America - Prof H Briggs The Classification and Development of the Carbonaceous Minerals of Organic Origin —*To be read by title only* - H V Lowry Properties of the Function Ein (x).—Dr A C Aitken and A Oppenheim On Charlier's New Form of the Frequency Function

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

SOCIETY OF ENGINEERS (at Geological Society), at 6 —E Kilburn Scott The Career of Matthew Murray

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —T C Gilbert and others Discussion on Earthing *versus* Artificial Earthing

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University) at 7 —S W Melson A N Arman, and W Bibby Surge Investigations on Overhead Line and Cable Systems

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol) at 7 —J W Rissik and H Rissik Heavy Duty Rectifiers and their Application to Traction Substations

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8 —W H Gray Dr J W Trevan, and Miss H W Bainbridge The Chemotherapy of Antimony

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 30 —Presentation of the Royal Gold Medal

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8 30 —Miss M N Searl Some Contrasted Aspects of Psycho Analysis and Education

HUNTERIAN SOCIETY OF LONDON (at Apothecaries Hall) at 9 —A E M Woolf The Surgical Aspects of Diverticulitis (Hunterian Oration).

TUESDAY, MARCH 3

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5 —Surg Capt. S. F Dudley Some Lessons of the Distribution of Infectious Disease in the Royal Navy (Milroy Lectures) (2).

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 —Sir William Bragg Recent Experimental Physics (4) Adhesion (2)

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5 30 —Clinical Meeting

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —S Zuckerman The Menstrual Cycle in the Primates III The Alleged Breeding Season of the Primates, with special reference to the Chacma Baboon (*Papio porcarius*).—Major S. S Flower Contributions to our Knowledge of the Duration of Life in Vertebrate Animals V Mammals —Malcolm A Smith Description of a New Genus of Sea Snakes from the Coast of Australia, with a Note on the Structures providing for Complete Closure of the Mouth in Aquatic Snakes —E Le G Troughton The Occurrence of a Male and Female *Grampus griseus* (Delphinidæ) at Sydney, New South Wales.—Dr E Schwarz A Revision of the Genera and Species of Madagascar Lemuridæ —Dr W J Dakin The Osmotic Concentration of the Blood of *Callorhynchus millii* and *Epiceratodus forsteri* and the Significance of the Physico-chemical Condition of the Blood in regard to the Systematic Position of the Holocephali and the Dipnoi —Rev E. J Pearce Report on the Haliplidæ (Coleoptera) Mr Omer Cooper's Investigation of the Abyssinian Freshwaters (Hugh Scott Expedition).

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6.15 —C C Paterson Address.

EUGENICS SOCIETY (at 20 Grosvenor Gardens, S.W 1), at 6 30 and 8 30 — Study Circle

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —W L Shand The Italian Riviera (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 45 —L A Legros Standardisation

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester University College Biological Society) (at University College, Leicester), at 8.—Prof A. R. Ling Polysaccharides

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at College of Technology Leicester).—H G Taylor Phenomena connected with the Collection of Current from Commutators and Slip Rings.

WEDNESDAY, MARCH 4

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —W A Macfadyen The Geology of British Somaliland (Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6 —C E Horton The Practical Correction of a Wireless Direction Finder for Deviations Due to the Metal Work of a Ship

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street W C 1), at 7 —W E Fretwell Public Baths and Wash Houses *Engineering Equipment and Data*

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall) at 7 30 —Dr C J Smithells Gases in Metals

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society), at 8 —Presidential Address —*Papers to be read by title* —H Ikuta The Investigation of Japanese Beeswax. —J Bamford The Deniges Oliver Test for Morphine.

ROYAL SOCIETY OF ARTS at 8 —W G Raffé Training for Advertising and Commercial Art

ROYAL SOCIETY OF MEDICINE (Surgery Section) at 8 30 —D C L Fitzwilliams Fat Necrosis —J Taylor Costo scapular Crepitus —A D Wright The Small Incision for Perforation of Peptic and Typhoid Ulcers —A E Porritt The Injection Treatment of Hydrocele, Varicocele, Bursitis, and Nævi —J P Ross The Anatomy of the Spinothalmic Tract in Relation to Cordotomy —J P Hosford Prognosis in Fractures of the Carpal Scaphoid —R H Boggon Removal of the Stellate Ganglion in Raynaud's Disease

THURSDAY, MARCH 5

ROYAL SOCIETY, at 4 30 —W L Garstang and C N Hinshelwood The Kinetics of the Combination of Hydrogen and Oxygen the Influence of Iodine Dr D R Hartree Optical and Equivalent Paths in a Stratified Medium treated from a Wave Standpoint.—H J Phelps The Adsorption of Substances by Fuller's Earth —*Papers to be read in title only* —*Prof L J Mordell* The Arithmetically Reduced Indefinite Quadratic Form in n Variables —J S Foster The Effect of Combined Electric and Magnetic Fields on the Helium Spectrum II —F R Terroux The Upper Limit of Energy in the Spectrum of Radium E —K R Rao and J S Badami Investigations on the Spectrum of Selenium I —J K L Macdonald Stark Effect in Molecular Hydrogen in the Range 4100 4770 A —T Alty The Reflection of Vapour Molecules at a Liquid Surface —A E Moelwyn Hughes and C N Hinshelwood The Kinetics of Reactions in Solution I II

LINNEAN SOCIETY OF LONDON, at 5 —H E Forrest and others Discussion on The Relation of the Fauna and Flora of the British Isles to those of North America.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Surg Capt S F Dudley Some Lessons of the Distribution of Infectious Disease in the Royal Navy (Milroy Lectures) (3).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof J B S Haldane Respiration (3)

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society Newcastle upon Tyne) at 6 —Rear Admiral D W Taylor Variation of Efficiency of Propulsion with Variation of Propeller Diameter and Revolutions

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (Annual Meeting) (at Bristol University), at 7 30 —Chairman's Address

SOCIETY OF GLASS TECHNOLOGY (London Section) (at Science Museum, South Kensington), at 7 30 —Discussion on Furnace Design —T C Crawhall Some Early Types of Glass Furnaces.—F W Hodkin Design of Modern Pot Furnaces —L E Norton Design of Modern Tank Furnaces

CHEMICAL SOCIETY, at 8 —F L. Gilbert, R R Goldstein, and Prof T M Lowry: Studies of Valency Part XV Absorption Spectra of Polyhalide Ions —R V Henley and E E Turner The Reactions of Substituted Ammonium Aryloxides and of Related Compounds Part I The Preparation and Thermal Decomposition of some Tetra substituted Ammonium Aryloxides

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.—Major P G Edge The Uses and Scope of Vital Records in the Tropics.

FRIDAY, MARCH 6

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10 30 A M —Discussion on Effects on Hearing after Fractured Base of the Skull Lessons Resulting Therefrom

ROYAL SANITARY INSTITUTE (at Guildhall, Swansea), at 8 —H R. Tighe and others Discussion on The Rheumatic Child —Dr J M Morris E Morgan, and others Discussion on Housing

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —Dr G M B Dobson A Photoelectric Spectrophotometer for Measuring the Amount of Atmospheric Ozone —G F Tagg, Practical Investigations of the Earth Resistivity Method of Geophysical Surveying —W E Pretty: Displacement of Certain Lines in the Spectrum of Ionised Oxygen (O II, O III), Neon (Ne II), and Argon (A II).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith Demonstration of the Nerve Supply of the Alimentary Tract and the Nature of Auerbach's Plexus

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (in Grosvenor Restaurant, Glasgow), at 6.30.—Annual Business Meeting

SOCIETY OF DYERS AND COLOURISTS (jointly with Society of Chemical Industry) (at Engineers Club Manchester), at 7 —S. M Neale The Action of Caustic Soda on Cellulose.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —J Urmston The Electrical High Pressure Testing of Cables and the Localisation of Faults

JUNIOR INSTITUTION OF ENGINEERS (at Science Museum), at 7 —The Historic Locomotives at the Museum

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —A M Hug The Netherlands East India State Railways and Electrification (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7 —Informal Meeting

GEOLOGISTS ASSOCIATION (in Architectural Theatre, University College), at 7 30 —Dr C A Matley The Deserts of California (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Dr G M B Dobson Ozone in the Upper Atmosphere and its Relation to Meteorology

SATURDAY, MARCH 7

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Lord Rutherford Recent Researches on the Alpha Rays (1).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (at Bristol).

PUBLIC LECTURES

SATURDAY, FEBRUARY 28

HORNIMAN MUSEUM (Forest Hill), at 3 30 —A M Hocart Spirit Worshippers of the South Seas

MONDAY MARCH 2

UNIVERSITY OF LEEDS, at 5 15 —Prof G Elliot Smith Some Factors in Mind Making

SCHOOL OF ORIENTAL STUDIES, at 5 15 —Prof B Hrozny Excavations of Kultepe The Hittites (Succeeding Lectures on Mar 3 and 4)

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5 30 —Dr W Rosenhain Hardness and Hardening (Succeeding Lectures on Mar 9, 16, and 23)

TUESDAY, MARCH 3

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15 —Dr C H Andrewes Immunity in Virus Diseases (1).

GRESHAM COLLEGE, at 6 —A R Hinks Astronomy in Twelve Chapters a Summary of Recent Advances (Succeeding Lectures on Mar 4, 5, and 6.) (Gresham Lectures)

WEDNESDAY, MARCH 4

KING'S COLLEGE, LONDON, at 5 30 —Dr H P Biggar The Great Age of Discovery The First Explorers of the North American Coast.

UNIVERSITY COLLEGE at 5 30 —Dr C Pellizzi Pisa (*in Italian*).

BELFAST MUSEUM AND ART GALLERY, at 8 —A P Fitzgerald Traffic Dangers and how to avoid them

FRIDAY, MARCH 6

CHEMICAL SOCIETY (at Institution of Mechanical Engineers) at 5 30.—Prof H Wieland Studies on Biological Oxidation (Pedler Lecture).

SATURDAY, MARCH 7

HORNIMAN MUSEUM (Forest Hill) at 3 30 —Miss I D Thornley Mediæval Maps and Travellers Tales

CONFERENCES.

FEBRUARY 27 AND 28.

ASSOCIATION OF TECHNICAL INSTITUTIONS (at Merchant Taylors Hall, E C 2).

Friday, Feb 27, at 11 A.M —Lord Eustace Percy Introduction of Major Gen Sir Philip Nash as President Elect

Principal B Mouat Jones *Technical Education in Russia.*

Friday, Feb 27 (*afternoon*) and *Saturday, Feb* 28 (*morning*)—

G H Gater A Descriptive Account of Technical Education in London

Comyns Carr Industrial Administration

Principal J A Todd National Certificates in Commerce.

J W Ramsbottom Commercial Education in America.

MARCH 5 AND 6.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting).

Thursday, Mar 5 (at Chemical Society), at 2.30—

Dr W H Gibson Flax Wax and its Extraction.

Dr R G Israel The Recovery of Gum from Fossil Kauri Timber

I W Humphrey *The Extraction of Terpene Chemicals from Waste Pine Woods*

(At Institution of Civil Engineers), at 6 30.—Baron Gian Alberto Blanc The New Italian Leucite Industry (Public Lecture).

Friday, Mar 6 (at Hotel Victoria), at 11 A M —Presentation of the Osborne Reynolds Medal, the Moulton Medal, and the Junior Moulton Medal

At 11 45 A.M —The President and others Discussion on The Education and Training of the Chemical Engineer

At 2 15.—Dr D M Newitt The Flow of Gases at High Pressures through Metal Pipes

CONVERSAZIONE AND EXHIBITION.

SATURDAY, MARCH 7

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W C 1), at 3.

SATURDAY, MARCH 7, 1931.

CONTENTS

Editorial and Publishing Offices
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Scientific Method in International Affairs.

THERE is a widespread tendency to hold science, and possibly chemistry in particular, responsible for many of the worst evils of modern warfare, which is perhaps the more dangerous to society because it is apt to discredit the voice of science When a distinguished chemist like Dr H Levinstein points out that attempts at chemical disarmament or the abolition of chemical warfare, except as part of a general disarmament plan, are largely futile and may be highly dangerous because of the close relationship between chemical warfare and the ordinary operations of chemical industry, he is straightway charged in some quarters with a fatalistic war mentality

When the charge against science is examined a little more closely, its gravamen will be found to reside in part in the prejudices of those whose deep-rooted habits and instincts have been disturbed by the impact of scientific discovery Not only have the character and potentialities of warfare been transformed by scientific discoveries and their industrial development, but also scientific methods of transport and of sanitation have enormously enlarged its scale and scope The ramifications of modern warfare extend so deeply into the fabric of industrial life that all distinction between combatant and non-combatant has largely disappeared

It is essentially applied science that has made warfare a matter no longer of armies and navies but of whole populations, and this and the failure of defensive measures to keep anything like pace with the development of offensive weapons have forced on civilisation the realisation that we must learn alternative methods of settling our international disputes or face the probability of the destruction of civilisation The supreme lesson of the War is that war between the highly civilised nations has been industrialised, and by its all-embracing needs has ceased to be a directable instrument af policy

When the control and direction of war are no longer in the hands of statesmen, its renunciation as an instrument of national policy becomes inevitable Fundamentally, it is true that just as the growth of modern science changed human relationships and, finally, by mastering the forces of Nature, made slavery an anachronism, so it has now changed the relations and policies of nations and challenges society to find a substitute for war Beneath this challenge there lies man's imperative need of retaining or securing intelligent control

over social forces if he is to continue to be master of his fate, and of finding new methods now that the danger and inadequacy of the old are revealed

While, however, most thoughtful men have welcomed the renunciation of war as an instrument of national policy, only the foolish or fanatical imagined that international disputes or causes of war would forthwith disappear The problem of peace is, in truth, exceedingly complex Not all the world is civilised, nor all that claims to be, and in the uncivilised condition of the world, war has formerly been an instrument against criminal aggression as much as it has been such an instrument itself There is need for the development of a science of peace not merely the elaboration of alternative methods of settling international disputes, but also the scientific study and impartial examination of all the complex factors, economic, social, political and racial, involved in controversial problems which are sources of international friction and possible *casus belli*, if the Pact of Paris is to be transformed from a pious hope or gesture into an abiding and dominant factor in international relations It is primarily from science that society must learn scientific principles and methods of unravelling such problems and reducing them to their elements, and the responsibility for constructive thought and statesmanship is one from which scientific workers cannot escape

A striking example of the efficacy of such scientific methods when applied to international affairs is to be found in the Pacific The impartial research carried out during the last five years by the Institute of Pacific Relations on such delicate matters, involving embittered national feelings, as the South Manchurian railway, the exclusion of Japanese immigrants from California, extraterritoriality in China, have transformed the menacing problem of the Pacific into one that promises to yield to treatment that is essentially scientific Research into questions like food and population in their bearing on emigration and immigration, for example, has done much to facilitate the settlement of acute problems on the basis of facts and not of prejudice with its evitable friction So successful, indeed, has been this method that when the volumes recording the preparatory work of the Kyoto Conference of the Institute were presented at Geneva last year, the Secretary-General of the League of Nations expressed the hope that this method of dealing with dangerous issues might soon be applied to Europe

As a direct outcome of this work of the Institute of Pacific Relations, Prof J T Shotwell, its research director, worked out during the same Assembly a scheme for a European institute of research constituted on similar lines. This institute is intended to apply the spirit and technique of scientific inquiry to the economic and social problems incidental or inimical to a civilisation of peace It will be non-political, and its aims are to study the social, economic, and cultural problems common to various nations, more particularly the problems arising from invention and discovery, to extend international co-operation in this field, to co-ordinate the results of research and, in the light of the facts thus found, in concert to investigate the underlying causes of international difficulties Its functions will be solely those of research and publication of the facts as ascertained

Although the importance of this proposal was recognised by the delegates of several nations, it has yet to receive official recognition and discussion The scheme must commend itself to all scientific thinkers as a sane alternative to our present method of handling controversial questions and allowing them to be inflamed by partisan propaganda It is a method by which science can assist society through the dangerous interval between the renunciation of war, as too dangerous an instrument, and the firm establishment of other methods of dealing with international disputes

Already the technique and efficiency of conference are being steadily perfected The proposed institute offers a fair prospect of eliminating political propaganda and reaching agreed settlements as a result of scientific inquiry. It opens fields of constructive activity before the Institute of Intellectual Co operation and before such national institutions as the W H Page School of Historical Research and the Royal Institute of International Affairs in Great Britain However unjustly science has been blamed for the misuse of scientific discoveries, scientific men have not always been fully mindful of their responsibility as citizens No opportunity like the present has, however, yet confronted them of promoting the scientific study of international relations and ensuring the use of science for constructive purposes Wisely used and directed, the projected institute of research may demonstrate that the humanising effect of scientific thought on *res publica* is no less profound than its application in industry. That quest for truth which inspires every scientific investigator supplies also the driving force for this experiment: *Magna est veritas et praevalebit !*

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Diamagnetism, Field Strength, and Crystal Structure.

RATHER a long time ago,[1] I directed attention to the fact that there seemed to exist a correlation between the following three properties of a metal (*a*) the crystal system to which the metal belongs, (*b*) the change in electrical resistance of the metal in a magnetic field, (*c*) the diamagnetic susceptibility, and possibly (*d*) the Hall effect

As an example I gave the following data

	χ	
Bismuth	$-1\,40 \times 10^{-6}$	hexagonal
Graphite	-5	
Antimony	$-0\,815$	
Tellurium	$-0\,303$	
Cadmium	$-0\,185$	
Zinc	$-0\,151$	
Silver	$0\,201$	regular
Gold	$-0\,152$	
Lead	$-0\,120$	
Copper	$-0\,085$	

Beginning with bismuth and ending with copper, the metals are given in the order of biggest change of resistance in the magnetic field In the same paper I came to the conclusion, when reviewing the results of D E Roberts[2] on the change of resistance of graphite in the magnetic field, that the so called free electrons could not be made responsible for the conductivity in this case, as the electrons clearly do not show any influence of a Lorentz force acting on them, which should be impossible in the case of the electrons being free It followed that the electrons have to go from one atom to another one that is, they are almost entirely bound, as in the case of graphite, or partly bound, as in the other metals One would say now that it is clear that the outer electrons of the atoms are responsible for a big part of the electric conductivity, and at the same time they are in a large way responsible for the diamagnetic susceptibility In the case of bismuth, the fact that the directions of maximum change of conductivity and of maximum susceptibility are at right angles indicates this still more strongly

As seen, those views were derived immediately from the direct results of measurements, yet they do not seem to have attracted much attention No idea, however, was offered as to the meaning of the relationship, In this respect, during the last few years, following the same mode of reasoning, Ehrenfest has made some useful suggestions in his papers on the diamagnetic susceptibility of bismuth[3] For this substance he states a working hypothesis agreeing with the views mentioned above, and giving at the same time an explanation of the very big value of the diamagnetic susceptibility of bismuth As is well known, he explains the extraordinarily high susceptibility of bismuth by the fact that in this metal the outer electrons do not move around a single atom but around several of them The surface of their orbits is then large, and hence there is high susceptibility It seems to me that this theory is a very valuable help in understanding the results of the susceptibility measurements

It was the idea of 1914 that made us undertake new measurements Mr Schubnikow and I had found that the change of resistance of highly purified bismuth is a very complicated function of field strength and orientation of the axes at low temperatures Now here we can decide whether such a relationship as mentioned does exist really for bismuth: the diamagnetic susceptibility up to now had always been found to be a very simple and regular function of the field strength and the orientation of the axis[4] If the suggested relationship exists, this should no longer be the case for crystals that show a complicated change of resistance We have had some very pure crystals grown, and Mr Van Alphen and I have measured their susceptibility as a function of the field strength at 14° K and 20° K The result was in quite good agreement with our reasoning This will be seen from the accompanying graphs, which we publish without drawing further conclusions from them Fig 1 gives the susceptibility as a function of the field In Fig 2 the magnetisation curves of bismuth are given In the same graph the curve is given indicating the change of resistance of bismuth with the field strength (already described by Schubnikow and De Haas[5]) It is clear that the curve showing change of resistance, indicated by ⊡, and the curve showing the magnetisation, indicated by △, are closely related: in fields where the resistance increases, the magnetisation remains nearly constant, where the magnetisation increases, the resistance remains constant This seems to indicate the double part played by the outer electrons: when adding

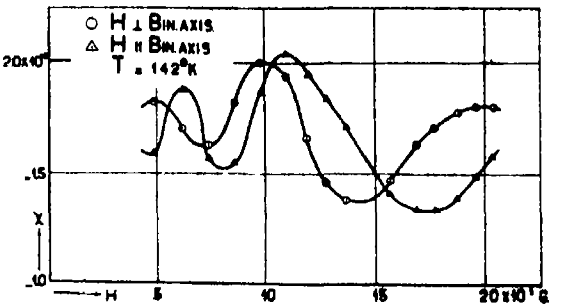

FIG 1

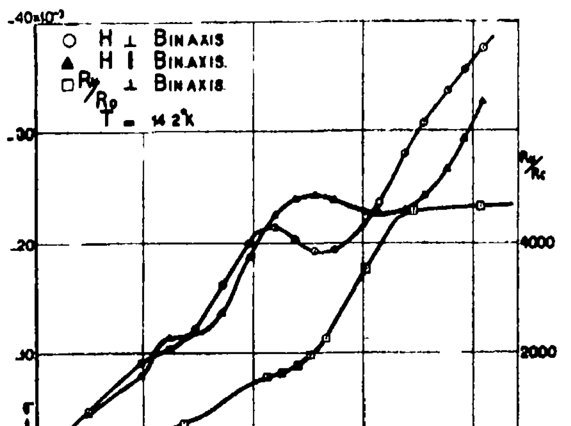

FIG 2

much to the susceptibility, they do not change the resistance, and vice versa

Though I am not able to give a suggestion of a theory which would be capable of predicting the curves, there is one remarkable fact to which I wish to direct attention, and for which I should like to suggest a possible explanation The curves not only show parts where the magnetisation remains constant in an increasing field, but also where this value even decreases It seems to me that this may be due to

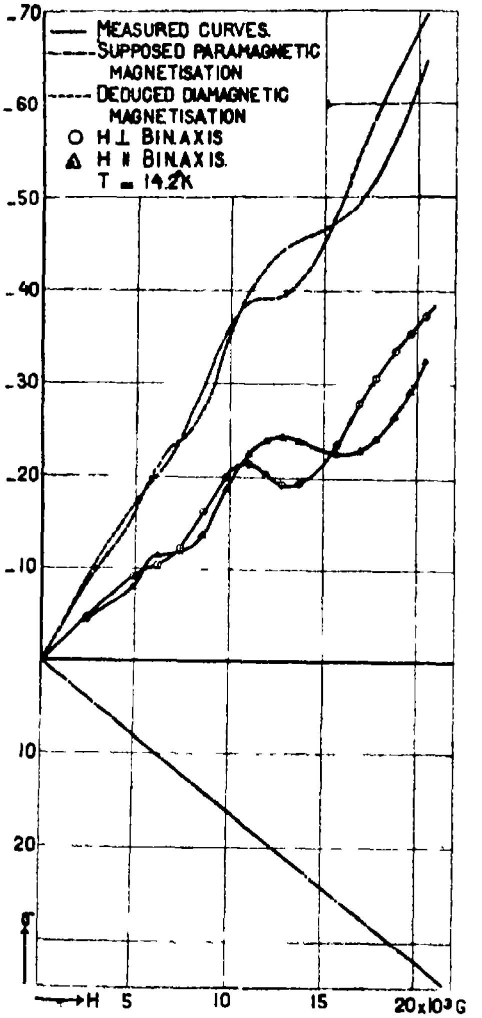

FIG 3

a superposition of the diamagnetism of the outer electron, which may show then always either an increasing or constant value, and a paramagnetism, due to the rest of the atoms, which would show a steadily increasing value Fig 3 indicates this theory the straight line gives the supposed paramagnetic magnetisation From this and from the measured curves (which are the same as in Fig 2) the upper curves, giving the supposed behaviour of the diamagnetic magnetisation, are deduced The fact that only at very low temperatures does the decrease of magnetisation take place would be due to the fact that at higher temperatures the paramagnetism (which might be supposed to follow to a first approximation the Curie law) is still too small to have this influence In support of this suggestion it may be noted that whereas the diamagnetism increases rather much from room temperature to the boiling-point of hydrogen, no further increase takes place between the boiling-point and the triple point the increase of diamagnetism would be compensated for in this region by the increase of the paramagnetism. The increase in diamagnetism may be due to the fact that the large orbits of the Ehrenfest theory are disturbed at higher temperatures the larger temperature motion of the atoms in the lattice may account for this, the large motions of the atoms caused by the melting of the metal destroys them entirely However, the mean paramagnetic moment of the rest of the atom would have to be small in order to show the right value of magnetisation in the temperature region of liquid hydrogen Anyhow, further work at the temperatures of liquid helium will bring more light in these questions

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[1] W J de Haas, *Proc Royal Acad Amsterdam*, vol 16, p 1110, 1914 W J de Haas, *Kon Akad v Wet Amsterdam*, versl 22, p 90, 1914

[2] D E Roberts, *Ann d Phys*, 40, p 453, 1913

[3] P Ehrenfest, *Physica*, 5, p 388, 1925, and *Zeit f Phys*, 58, p 719, 1929

[4] J C McLennan and E Cohen, *Trans Roy Soc Canada*, 23 (section 3) 159, 1929

[5] L Schubnikow and W J de Haas, NATURE, 126, p 500, 1930

Change of Resistance in Magnetic Fields

UNTIL recently, the theory of conductivity put forward by Sommerfeld and Bloch did not succeed in explaining the change of resistance in magnetic fields If R' is the resistance in a magnetic field H, R that without magnetic field, then for weak fields the change of resistance $\Delta R = R' - R$ follows theoretically as well as experimentally the law [1]

$$\Delta R/R = B\ H^2 \qquad (1)$$

The absolute magnitude, however, of the coefficient B was found experimentally to be about 10,000 times greater than Sommerfeld's theoretical value But according to Peierls,[2] one can obtain the right order of magnitude for the magneto resistance effect by taking into account that the electrons in a metal are not moving freely, but are strongly influenced by the potential of the metal atoms Peierls gets the result

$$B = B'\ \kappa\ \left(\frac{E_0}{kT}\right)^2 \qquad (2)$$

where B' is the value of B calculated by Sommerfeld,[3] E_0 is the limit energy of the Fermi Dirac distribution of the conductivity electrons, which is about 300 times as big as kT for room temperature, and κ is a constant which measures the deviation of the motion of the conductivity electrons from field-free motion In single crystals κ depends on the direction both of the applied magnetic field and of the current relative to the crystal axes, but not on the temperature The value of κ required to explain the experiments is about 0 1, which seems reasonable, whereas the exact theoretical value cannot be calculated at present

A check of the theory can, however, be made by considering the temperature dependence of the magneto resistance effect Inserting Sommerfeld's value for B' and E_0,[4] we get

$$B = \frac{\pi^2}{12}\ \frac{1}{(en)^2}\ \kappa\ \frac{1}{R^2} \qquad (3)$$

Here all factors on the right-hand side are independent of the temperature except the specific resistance R As regards dependence on temperature, therefore, the relative change of resistance in a given magnetic field is inversely proportional to the square of the resistance, the absolute change is inversely proportional to the resistance itself The same result may be obtained by a more exact calculation, using Bloch's conductivity

theory If B_0 and R_0 refer to room temperature and B and R are measured at any other temperature, we have from (3)

$$B_0 = B\left(\frac{R}{R_0}\right)^2 \qquad (4)$$

The two last columns of the accompanying table are calculated according to (4) and show a good agreement

VARIATION OF B WITH TEMPERATURE

	Kapitza's observations at the temp of				$B \times 10^{11}$ at room temperature		
	CO_2 + ether		Liquid nitrogen		Obs by Kapitza	Deduced by Equ (4) from experiments at temp of	
	$B \times 10^{11}$	R/R_0	$B \times 10^{11}$	R/R_0		CO_2 + ether	Liquid nitrogen
Mg	4 9	0 68	55	0 17	2 15	2 25	1 6
Zn	1 87	0 68	19 7	0 19	—	0 87	0 72
Cd	6 6	0 68	33	0 22	—	3 0	1 6
Mo	1 28	0 61	15 4	0 136	—	0 46	0·29
Be	—	—	40 4	0 33	9 8	—	4 4
Ga	25	0 65	174	0 21	—	10 3	7 8
As	50	0 6	470	0 16	16 4	18	12

between each other and the directly observed value of B_0 given in the preceding column

H BETHE

Cambridge

[1] For the theoretical explanation of the deviation from this law for strong fields observed by Kapitza (*Proc Roy Soc*, A, **123**, 292, 1929) see N H Frank, *Zeit f Physik*, **63**, 596 1930

[2] Leipziger Vorträge, 1930, p 75, see specially p 85

[3] *Zeit f Physik*, **47**, 1, 1928

[4] See Sommerfeld, l c, equations (77*a*), (34) (42*a*), (48*c*) Our E_0 is Sommerfeld's $kT \log A$ n is the number of electrons per cm³ of the metal

Faraday's First Successful Experiment on Diamagnetism

IN my discourse on "Tyndall's Experiments on Magne crystallic Action", delivered at the Royal Institution on Friday, Jan 21, 1927, and published as a supplement to NATURE of May 7 of that year, I gave a short account of Faraday's first successful experiment on diamagnetism He used a piece of heavy glass which he described in his Diary as No 174 At that time I searched through all the specimens of Faraday's heavy glass in the Royal Institution but was unable to find it It has just turned up, being contained in a box which Mrs Tyndall has most kindly allowed me to examine

The box was presented to Prof and Mrs Tyndall by Faraday, and it contains a number of specimens which the latter used in this series of diamagnetic experiments This piece of glass is actually the first object in which Faraday found diamagnetism to be shown

Mrs Tyndall has kindly promised that the box and its contents shall be on show at the Faraday Centenary Exhibition in the Albert Hall next September

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The Royal Institution,
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London, W 1, Feb 17

Cambridge Expedition to the East African Lakes

THE expedition, which is being financed by scientific societies and the University, left England in October and is at work on the rift valley lakes of Kenya The object of the expedition is twofold First, to continue studies on the ecology of the East African lakes which were started by the Government fishing surveys of Lakes Victoria, Albert, and Kioga in 1927–28, and at the same time to make thorough collections of the faunas of Lakes Rudolf, Baringo, and Edward, which have previously received only a cursory scientific examination, secondly, by studying the old lake beaches and deposits, to continue farther north the investigations made around Lakes Nakuru, Elmenteita, and Naivasha by Mr L S B Leakey and the biologists of the East African Archæological Expedition It is hoped to link up evidence from lake beaches, the distribution of the present lake faunas, and the chemical constitution of the waters into a unified whole, and so to work out, so far as possible, the previous distribution of land and water during the pluvial periods

The personnel of the expedition consists of Dr E B Worthington (leader), Mr L C Beadle, whose special study is that of the chemical constitution of the waters and its relation to the fauna and flora, and Mr V E Fuchs, geologist, who is concentrating on the old lake beaches In addition, through the collaboration of the Kenya Government, Capt R E Dent, assistant game warden, has accompanied the expedition, giving invaluable assistance in many ways

The first two months have been devoted to a preliminary examination of Lakes Naivasha, Baringo, and Rudolf, and to fixing camp sites and transporting boats to the lakes in readiness for future work Lake Rudolf lies far to the north, extending beyond the Kenya Abyssinia border Some difficulty was experienced in transporting the equipment and a 20 foot metal life boat, lent to the expedition by the railway authorities, the 260 miles beyond the railhead to the lake This is the second boat to have reached Lake Rudolf, the first having been lost some years ago, soon after her first cruise The lake is low lying in a wide desert area, so that the climate is hot, the daily shade temperature reaching 100° F Living under canvas is uncomfortable owing to the heat, the bad water, and the high winds prevailing Consequently a hut has been constructed out of local materials to afford protection and to serve as a laboratory

All three lakes lie in closed drainage basins, and there is no previous information about their depths, except that of Naivasha This lake, at 6200 ft above sea level, has an area of 60 square miles and a maximum depth of 20 metres Baringo, at 3000 ft, has an area of some 50 square miles, and its floor proves to be silted up to an almost even depth of 7 metres Lake Rudolf, a tract of water 180 miles long by some 30 miles wide, lies at 1400 ft above the sea The deepest sounding yet made is 63 metres near the middle of the lake, this shows that Rudolf, though a true rift valley lake, is of the shallow type By comparison with the lakes of the western rift it resembles Lake Albert, depth 47 metres, rather than Lake Tanganyika, depth 1435 metres, or Lake Nyassa, 786 metres

Lakes Naivasha, Baringo, and Rudolf are alkaline owing to soda derived from the lavas of the rift valley The water of Naivasha has an alkalinity of 0 003 normal, of Baringo 0 005 N, whereas Lake Rudolf consists of a strong solution of soda with a normality of 0 023 In the latter lake the concentration of soda salts due to evaporation and the recent lowering of the lake level have caused precipitation of lime from the water This can be associated with the deposition of calcareous tufa some distance above present lake level, and also must have had its effect on the constitution of the lake fauna

Concerning the faunas, Lake Naivasha, having a single small indigenous fish, *Haplochilus antinorii*, and lying in a populated area, has for the last five years been the seat of an experiment on the introduction of other fishes for commercial and sporting purposes. This must have altered the ecology considerably, and it may have caused the extermination of some small members of the invertebrate fauna The present

fauna of Lake Baringo is poor, but shows affinities with that of Lake Rudolf to the north. Rudolf has a rich fish fauna, showing marked similarity to that of Lake Albert in Uganda and of the Lower Nile. This is proof that the lake was formerly connected to the Lower Nile system, although the present watershed between the lake basin and the Sobat tributary of the White Nile is many hundred feet above the lake level. Lake deposits over a wide tract of desert country near by and a beach at 550 ft. above present lake level show definitely that the lake was previously of much larger extent than at present. By correlation of the beach levels and by further comparison of the living and fossil faunas, it is hoped to produce important evidence concerning the pluvial periods.

The next few months will be occupied by further work on these three Kenya lakes. Later in the year the expedition will move to Lakes Edward and George, by arrangement with the Uganda Government.

E. B. WORTHINGTON.

Jan. 19.

The Antiquity of New Caledonia

I HAVE just received from my friend M. Lucien Berland a very interesting discussion of the spider fauna of New Caledonia, with special reference to its origin.[1] It is stated that M. Piroutet (1917) has published a detailed account of the stratigraphy of New Caledonia, in which it is established that the island was entirely submerged about the end of the Eocene. The spiders, which were described by Berland in 1924, if we add a few later records, number 153 species from New Caledonia and the adjacent (and faunally similar) Loyalty Islands. These include nine endemic genera, and no less than 95 endemic species. It is suggested that this fauna, or rather its ancestors, reached the island during Oligocene time. Since then, various oscillations have occurred, but the island has not been completely submerged. The close resemblance of the fauna of the Loyalty group clearly indicates connexion with New Caledonia in comparatively recent times.

If it could be certainly established that New Caledonia received its fauna and flora not earlier than the Oligocene, we should have a very interesting means of estimating the subsequent rate of diversification and evolution. But after long consideration of the subject, both when in New Caledonia and while later working on the collections secured, I do not believe that M. Piroutet's postulate can be upheld. The central part of the island is elevated, with steep slopes, and it is quite probable that the whole surface, which may have been above the sea during Eocene times, has been removed by denudation. In such case the present stratigraphy could not well be made to prove the theory of complete submergence. But setting aside the geological evidence, I think the character of the biota accords much better with the theory of a very ancient island, formerly connected or nearly connected (presumably north westward) with continental areas, undergoing great changes of level, and at times nearly but not completely submerged.

On any other basis it would be difficult to account for the very remarkable flora and no less remarkable molluscan fauna. Rocks in the interior are considered to be of Triassic and Cretaceous age, and while their existence does not refute the theory of submergence, there was apparently a land mass during at least a large part of the Mesozoic. The flora, studied by Compton, Schinz, Guillaumin, and others, is of such a character that Prof. Seward was led to remark: "In some respects the vegetation of New Caledonia carries us further back in the history of plants than almost any other part of the world". Guillaumin (1922) estimated the endemism of the flora as 76.5 per cent.; Compton's collections, made so recently as 1914, added ten new genera and 230 new species. Resemblance to the flora of Australia is shown by the presence of such woody genera as *Callistemon*, *Kermadecia*, *Hibbertia*, *Grevillea*, *Stenocarpus*, and *Casuarina*. Strangely enough, there is not a single *Eucalyptus*. The lowlands along the coast appear at first sight to be largely covered by *Eucalyptus*, but on closer inspection the tree is seen to be the *niaouli* (*Melaleuca leucodendron*). This tree must have some special facility for distribution, since it occurs not only in Australia, but also so far north as Siam, where (as I learn from Dr. Kerr) it is called *samet*. Without going into further detail, it may be said that it is wholly incredible to a botanist that this flora has acquired its peculiar features since some time in the Oligocene. It is equally incredible that since that time the now peculiar types migrated from somewhere else. Quite significant is the very small number of native grasses and the large number of endemic orchids. There is only one cycad (*Cycas neocaledonica*), which we saw growing by the coast near Bourail.

When we come to the snails, they tell a similar story. The endemism is tremendous, and the fauna has the aspect of great antiquity. The characteristic large edible snails, of the genus *Placostylus*, have very close relatives on Lord Howe Island, and the genus is also represented in New Zealand. The *Placostylus* of Fiji and the New Hebrides are of a different appearance and seem to be generically or subgenerically separable. (Ancey proposed the generic name *Diplomorpha* for a New Hebrides species.) The highly characteristic genus *Platyrhitida* occurs in New Caledonia and Lord Howe Island,[2] but the latter island has some remarkable snails apparently without relatives in New Caledonia. A curious case is that of the endemic *Papuina mageni* (*Bulimulus mageni* Gassier), which I found living on trees at Bourail. As Mr. Iredale pointed out to me, it appears to be nearly related to *P. folicola* Hedley of Queensland, found on leaves. It is, however, quite distinct as a species.

In other groups New Caledonia shows similar evidences of a very ancient fauna. There is the extraordinary and unique bird, *Rhinochetus jubatus* Verr. and Des Murs, forming a very distinct family. There are 18 endemic species of the earth worm genus *Acanthodrilus*. The leeches include a special genus. The diplopods or millipedes, always a good index of past conditions, present an astonishing array of endemic forms—including five peculiar genera, one of which cannot be readily placed in the system. The terrestrial Isopoda include 44 species, all endemic except two introduced cosmopolitan forms. There are numerous endemic land planarians.

On the other hand, if we postulate continental connexions in late Tertiary times, it is impossible to explain the total absence of numerous groups of animals and plants which are common in the regions which might conceivably have been thus connected.

Having written the above, I tried to develop a new argument on the other side of the question, and the following, based on the ants, appears to be worth offering. The ants of Baltic amber (Oligocene) are very well known, and have been rather recently (1914) revised by Wheeler. There are 43 genera, of which 19 (44.1 per cent.) are extinct. All the species are considered to be extinct, but some are almost identical with living forms. Five of the extinct genera are so peculiar that Wheeler classifies them as of uncertain affinities. Now, supposing New Caledonia to have received its fauna during the Oligocene, and nothing since, the present ant fauna of that island might be expected to be quite as peculiar as that of the amber,

and even more so, owing to the evolution on the island since the Oligocene

The ants of New Caledonia (77 species and varieties) were listed by Wheeler in 1927 I collected what ants I could, and sent them to Mr John Clark of the Melbourne Museum I have not been able to get any information from Mr Clark, but a mutual friend wrote me that he examined them and found no new species Thus it is probable that the ant fauna is fairly well known The commonest, or at least most conspicuous species, is *Polyrhachis guerini* Roger It must be said of these ants that, compared with those of the amber, they are a very ordinary lot, and show little evidence of the antiquity which we infer from the plants and molluscs Taking the ants alone, we should suppose them to have arrived (not counting those introduced by man) no earlier than the Pliocene There are only two endemic genera (and one sub genus), but 64 per cent of the species or races are endemic

Certainly, if New Caledonia had received its fauna during the Oligocene, and nothing since, we should expect to find 100 per cent of endemism as regards species, and as for genera, there is much truth in Mann's remark (1919) that "the Melanesian sub region (including Vanikoro, the New Hebrides, New Caledonia, and Fiji), like the Chilean and Malagasy, might be described as a biological conservatory, where types once tropicopolitan have been isolated and preserved, free from invasion" Yet the last sentence is too extreme, for there evidently has been invasion during late Tertiary time, but apparently of the accidental type which is characteristic of islands Neither the Australian nor the Malayan biota has come over as it must have done with complete land connexion We may infer that many of the peculiar generic types of New Caledonia had their origin on the land mass of which it is a fragment, but this cannot, in any particular case, be actually proved

T D A COCKERELL

University of Colorado, Boulder,
Jan 12

[1] *Comptes rendus Acad Sciences*, Paris, vol 176, p 1668 See also an account of the spiders of the Loyalty Islands *Bull Soc Ent France*, vol 54 p 387, 1929

[2] *Platyrhitida balli* (Brazier) on Lord Howe Island I am indebted to Mr Iredale for a specimen

The Meaning of Existence

I DO not know whether anyone has directed attention to the striking agreement of the conclusion of "The Mysterious Universe" with the final form in which Kant expressed his conclusion concerning the nature of the objective world in the "Critique of Judgment" My particular reference is to Remarks 1 and 2 appended to the 57th Section In this passage Kant makes the distinction between the *Æsthetic Idea* and the *Rational Idea*, and it marks the transition from the consideration of the æsthetic judgment of taste to that of the teleological judgment of purpose in Nature But the real significance of the passage is seen to lie in Kant's complete grasp of the relation between the intuitive knowledge of the world in sense perception and the objective knowledge of the world in scientific reasoning It is this which makes Kant's theory so relevant to the modern scientific interpretation of physical reality

I do not claim for Kant any premonition of Sir James Jeans's conception of God as the great mathematician Such a concept of God follows from a view of the nature of scientific truth impossible in Kant's generation What I have in mind is the forcible bringing home of the fact that the real world of science resembles a thought rather than a thing Kant expressed it in terms of purposiveness In the æsthetic judgment of taste, the imagination judges the beautiful in accordance with the principle of a purely subjective purposiveness, in the teleological judgment, the understanding objectifies purpose in Nature In other words, Nature is objective thought

It is this final outcome of Kant's theory which brings his philosophical problem into line with the modern scientific problem It starts with the autonomous world of sense perception, which, as Berkeley proved in a simple argument which has never been undermined, is entirely subjective Our perceptions exist nowhere but in our mind The objectivity of the world is a logical inference, and the form it assumes is a construction of thought Is it strange, then, that when we study this world scientifically we find it resembles a thought rather than a thing? What we find difficult to understand is that in discovering this we are not discovering the world to be illusion, but positively real When we say the world is thought, we mean that mind is original existence, that perceiving, thinking, reasoning are the expression of its activity, and that thought is the fixed form of its objectivity This certainly was the meaning of Kant, however halting his earlier attempts to express it It is, if I mistake not, Sir James Jeans's meaning, and certainly it is mine

H WILDON CARR

University of Southern California,
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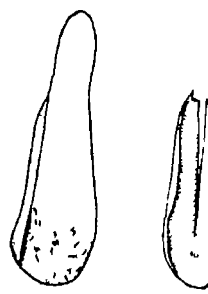
Los Angeles,
Feb 5

Morphology of the Pharynx of Female *Culicoides* and its Taxonomic Importance

WHILE studying the structure of the pharynx and buccal cavity of some female *Culicoides* in an attempt to correlate their affinities, if any, with the taxonomy of the group, it was found that the structure varies considerably in both the local and exotic forms In the case of *Culicoides pulicaris*, a European species, it is found that the pharyngeal armature is distinctly of *Phlebotomus* type,[1] inasmuch as it not only bears distinct serrations posteriorly, but also is furnished along one of its walls with a thin, rather deeply chitinised, pigmented ridge, which in its turn carries a series of backwardly directed teeth (Fig 1, *a*) The two local Indian species, namely, *Culicoides oxystoma*, Kieff, and *C peregrinus* Kieff, on the other hand, have pharyngeal armatures which apparently bear very little similarity with its related exotic form The pharyngeal armature of these two forms is horseshoe shaped (Fig 1, *b*), that is, the two arms are free at the proximal end, and they appear to be undivided at its distal region, leaving a very thin lumen in between, which communicates posteriorly with the alimentary canal The two free ends simulate the open ends of the shells of a bivalve mollusc, and each bears a few filamentous, outwardly directed processes The lateral fringes of the pharynx bear inwardly very fine serrations The differences between the structures of the pharyngial armature of the two Indian species are as follows In the case of *C oxystoma* the lateral edges of the armature are somewhat more overlapping in the middle, and the lateral serrations are less distinct than those of *C peregrinus*



a *b*
FIG 1 ×200

I have also traced two sets of muscles on each side of the dorso lateral walls of the pharynx which apparently aid in the creation of vacuum, thus causing an inrush of blood through the fine channel of the pharynx

Whether the structure of the pharyngeal armature will play an important rôle in the classification of female *Culicoides* depends considerably on observations on a larger scale, meanwhile, a preliminary observation of this nature, to elicit further observations on the subject, would not be out of place A detailed and more confirmatory result in this direction will be published elsewhere as specimens of both local and exotic types are forthcoming

S MUKERJI
(Entomologist under the Indian Research Fund Association)
Kala azar Research Laboratory,
School of Tropical Medicine and Hygiene,
Calcutta, Jan 3

[1] Adler, S, and Theodor O, *Bull Ent Res*, **16**, pp 399 405, 1925–1926

The False Killer Dolphin

WITH regard to the occurrence of *Pseudorca crassidens* in Ceylon, to which reference was made in NATURE of Dec 6, 1930, p 892, and Jan 10, 1931, p 60, the full circumstances were not recorded at the time, owing to a printer's lapse An account of the stranding of a school of 167 false killer dolphins off the northern coast of Ceylon is now in the press and will be published in the *Ceylon Journal of Science* (Sec B) This species was previously recorded from Ceylon about forty years ago

The distribution of this species presents points of exceptional interest Apart from the few records from the north west European coast, the known distribution of *Pseudorca crassidens* is not inconsistent with the view that it is a sub antarctic oceanic form which occasionally wanders northwards in large schools into the Pacific, Atlantic, and Indian Oceans Is it not possible to regard the occurrence of this species in the North Sea as fortuitous ? I am inclined to this opinion and regard the three recorded appearances of this cold water species off the coasts of South India and Ceylon as less remarkable than the comparatively few records from the North Sea

Whales, presumably from the southern seas, are not infrequently stranded on the Ceylon coast, but precise records of such occurrences are difficult to obtain, owing to (*a*) the ignorance of the fishing population, (*b*) the inaccessibility of a large part of the coast, and (*c*) the rapidity with which a whale carcase disintegrates in the tropics

Pseudorca crassidens has been described as a common form in certain parts of the southern seas, and I agree with Sir Sidney Harmer that there is little justification for the statement that this species is on the verge of extinction

JOSEPH PEARSON
Colombo Museum,
Feb 4

An Unusual Ice Formation

ON the morning of Saturday, Jan 31, after a frosty night, we discovered in the bird bath on the lawn a remarkable ice structure The bath is a circular metal basin, 10 in in diameter at the rim, with a concave base admitting of a maximum depth of 2 in of water in the centre There was a solid mass of ice of not less than 1 in and not more than 1¼ in maximum thickness, with a level (though not smooth) surface 8 in in diameter From the centre of this rose a pillar of ice, in the form of a triangular prism, 2¼ in high, tapering slightly downwards and flat topped The plan was a nearly right-angled (very slightly obtuse-angled) triangle, the two shorter sides measuring 1¼ in and ¾ in respectively · the hypotenuse was slightly curved and irregular, not convenient for measurement When warm water was poured into the bath, the ice melted in contact with the sides, and the whole could easily be lifted out in one mass, the pillar being used as a handle Certain appearances suggested that the pillar might be hollow, but I did not break it across, so that must remain doubtful The combined block of ice was placed in a shaded place and, though melting slowly, retained its strange appearance through the whole of the day

I am indebted to a number of my colleagues, and particularly to Prof A O Rankine and Dr H T Ellingham, for a very interesting discussion of this phenomenon The most feasible explanation appears to be that freezing began, as usual, at the margin of the surface of the water, and ice crystals grew inward until the surface was completely frozen except for a triangular area in the centre At this stage there was a rapid fall of temperature and the water below the surface began to freeze quickly The expansion accompanying solidification caused the excess of volume to be forced through the triangular aperture, the water freezing as it rose

A MORLEY DAVIES
Arngrove, Amersham, Bucks,
Feb 10

Wisdom in Words

THE caption and the questions of "Inquirer" (NATURE, Jan 31, p 166) are salutary Is he, per chance, a reincarnation of Francis Bacon, who warned future experimentalists of the dangers of idols of the mind created by the speculative Schoolmen ?

The modern etymology of the word 'philosophy' has not been accepted by all scholars, including M Ragon, the French authority, of the last century, on the Egyptian mysteries He contended that ancient philosophers were scientific workers, and that their philosophy was a real science—not simply verbiage, that 'philos' does not represent here a noun, or mean 'affection' it is the term used for Eros, synonymous with πόθος, the universal, creative energy of Nature—the abstract 'desire' or procreative activity inherent in Nature Hence *philosophia* originally signified knowledge of the energies within objective phenomena, and *philosopher*, one who had assimilated in himself, or personified as it were, creative knowledge or the 'wisdom of creation', and could, therefore, experimentally demonstrate it The tradition may be true, then, that Pythagoras modestly refused to be called a philosopher ! W W L

William Hyde Wollaston

I AM collecting materials for a biography of William Hyde Wollaston (1766–1828), and would be most grateful for any documents or other information bearing on him which readers of NATURE could supply All documents would be carefully handled, and would be returned to the senders as soon as copied

L F GILBERT.
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Gower Street, London, W C 1,
Feb 6

The Audibility and Lowermost Altitude of the Aurora Polaris.

By Prof S Chapman, F R S

THE aurora polaris, after long study, remains in many respects mysterious, of late years, however, scientific opinion has been nearly unanimous in regard to its height in the atmosphere, locating it at about 100 kilometres and above Størmer has found trustworthy evidence, in a few cases, of its occurrence so low as 80 km Its upward extent is very variable, but at times it rises to a height of 800 km These very high auroræ seem to occur exclusively in the part of the atmosphere which, though viewed from stations in the night hemisphere, is itself still illuminated by the sun's rays, no very likely explanation of this remarkable fact has yet been proposed

The gradual accumulation of trustworthy photographic measures of the height of auroræ, observed simultaneously from two or more stations, since Størmer introduced his now well known methods, has steadily added strength to this conviction Yet from early times to the present day there have been occasional reports of auroræ situated at much lower heights, so as to be visible between the beholder and high land at no great distance Likewise there have been many accounts of auroræ having been *heard*, a thing scarcely to be credited if they are located at heights of 80 km or more Both kinds of observation have in general been viewed with suspicion

In 1918, Dr G C Simpson, in a letter to Nature (Sept 12, p 24), referred to the question of low auroræ, and recounted three cases that came under his notice during the 1910–12 Scott antarctic expedition he had asked his colleagues to direct his attention to any auroræ observed by them at low altitudes, in each instance he concluded, on personally viewing the aurora, that its situation below the clouds, or between the camp and neighbouring mountains, was only apparent—that chance circumstances combined to produce an optical illusion, distinguishable as such only on the closest scrutiny Indeed, on one of the three occasions a majority of his colleagues were not convinced by him that the appearance was only illusory

Such an examination, by a first-rate observer, of observations that were apparently anomalous, and contradictory of the results uniformly given by the best methods of observation, was of great value Since it dealt only with a few particular cases, it could not dispose of the possibility that in other cases the appearance of low auroræ was real and not counterfeit, yet it certainly showed that now and then appearances were very likely to deceive, and emphasised the need for caution in accepting reports even from the most trustworthy and convinced observers

The discussion has recently been carried to a further stage through the zeal of Mr J Halvor Johnson, of San Mateo, California, who for many years lived near, and beyond, the Arctic circle, and witnessed many auroræ During these years he observed, once only, in Alaska, in 1901, an unmistakably low aurora, which was visible between himself and a mountain about half a mile distant, rising to about 1200 feet above his own level Moreover, on this and but one other occasion he heard sounds accompanying the aurora At the time he had read little with reference to the aurora, and was ignorant of the prevailing opinion that the aurora is confined to the upper atmosphere In recent years his conviction, based on his own experience, that this opinion is not true in all cases, has led him to seek further evidence on the point, from other observers From few parts of the world is such information likely to be more readily available than from North America—Alaska and northern Canada Here, owing to the inclination of the earth's magnetic axis in this direction, a long stretch of the zone of maximum auroral frequency passes overland, in a region which, though inhospitable and sparsely populated, is yet inhabited by a large number (in the aggregate) of civilised men, including some, such as surveyors, and occasional professional men in small townships, of considerable intelligence and education Mr Johnson, recognising that low-level auroræ are at least rare, and apparently have not occurred at times and places where arrangements for measuring their altitude were available, in 1928 addressed a letter to each of the newspapers published in Alaska and the British Yukon Territory, seeking information in regard to auroral displays

In this letter Mr Johnson directed particular attention to the question of low altitude and sound, stating the position very fairly "much respectable testimony", on one hand, in favour of occasional sounds, and "exceedingly rare" close approaches of the aurora, and, on the other hand, the prevailing scientific disbelief, and the statements of many men who have travelled extensively in the arctic regions, that they have never heard auroral sounds He did not mention his own experience or conviction His letter was given a prominent place in the newspapers, and produced many replies, some of these he followed up by further direct correspondence He has lately published a small pamphlet "Concerning the Aurora Borealis" (29 pages, privately printed, at the Gazette Press, Berkeley, California, 1930), giving a selection of the letters (17 pages), accompanied by an introduction and brief historical account of the subject (11 pages) The writers of the letters include men from various stations in life, from "the simple pioneer and prospector, whose spirit of helpfulness outweighed his diffidence in writing, to the professional man of disciplined observational training"

This inquiry is in some respects similar to one made by Sophus Tromholt in Norway in 1885 Tromholt wrote in Nature (Sept 24, 1885, vol 32, p 499) that up to date, out of 103 replies bearing on the question of auroral *sounds*, 53 were from

writers who had personally heard such sounds, while a further 39 cited the testimony of others to the same effect, the remaining 21 declared they had never heard the sounds, or knew nothing of them It may be recalled also that in NATURE, Jan 8, 1927, vol 119, p 45, Prof Størmer reported that on Oct 15, 1926, H S Jelstrup and an assistant, at the observatory near Oslo, both heard auroral sounds during ten minutes which they were able to spend in the open watching the aurora, before continuing their observations, the sound was a very curious faint whistle, increasing and decreasing, seeming to follow exactly the vibrations of the aurora Unfortunately, Størmer had no successful photographs of the aurora during the period in question

Mr Johnson's pamphlet contains letters from twenty persons One of them does not refer to the two points here under discussion Seventeen testify to having heard sounds accompanying auroræ, and some cite one or more friends who can bear similar testimony, sixteen state that they have seen auroræ coming close to the ground, and, of these, twelve assert that they have seen the light against a background of mountains or other objects near the ground All these letters appear to be written in perfect good faith Several of the writers who have heard auroral sounds describe them as fairly frequent, others have heard them only on one or a very few occasions in many years

The sounds are variously described as "a swishing or rustle, like that of a silken skirt moving back and forth, very low, but yet plainly discernible", like those "that accompany small static discharges", like the sound made when "a couple of slices of good fat bacon are dropped into a red-hot pan", "they may attain a loudness comparable to that emitted by a high tension electric current when charging a set of horn gap lightning arresters", "quite audible swishing, crackling, rustling sounds", "a crackling so fine that it resembled a hiss", sounds "similar to escaping steam, or air escaping from a tire", "much like the swinging of an air hose with escaping air", "the noise of swishing similar to a lash of a whip being drawn through the air", sounds "likened to a flock of birds flying close to one's head", "not musical, it was a distinct tearing, ripping sound as when thin muslin is ripped or torn apart" One man at sea, in an open boat with four natives, on Oct 11, 1893, heard "the most fearful whizzling and crackling sounds, sounding at times as if thousands of firearms were fired within short distance", at the time there was "no wind and no clouds" Another writer mentions "loud reports similar to rifle cracks", "the air was still and the aurora was just above the tops of the birches", the few loud reports were followed by much crackling

Some of the accounts of low auroræ seen between the observer and terrestrial objects are very striking and circumstantial One writer states that he and his party (members of a government radio station, in the winter of 1917–18) were enveloped in "a light mist or fog-like substance in the aurora", a hand extended could be seen as if in a coloured fog, and a kaleidoscope of colours was visible between the hand and the body It was impossible to feel this visible fog or mist, and there was no dampness By stooping close to the ground it was possible to see under this light, which did not go below four feet from the ground The low-hung aurora lasted fifteen minutes, while great streaks and shafts of light came and went in the heavens The occasion was unique in the writer's experience

Another writer, during a brilliant auroral display, saw the light "play" down between himself and a steep glacial deposit bank about 125 feet away, he "stepped right into the aurora" Another saw an aurora between himself and a ten foot bank not more than one half-mile away, there was "immense light", "on the very surface", and a shaft of light shot up to an immense height Another in 1915 saw the familiar landscape "beautified by changing coloured lights which came and went rapidly, now bathing us, now withdrawing with a swish to a height of a mile or so", "it came down in streamers, or again as a fog (only much faster than fogs come, only a matter of seconds)", "we saw the tree trunks through the aurora", the colours being mostly, though not wholly, greens

These letters make it difficult to deny that auroræ occur, very rarely, quite near the earth, and are sometimes accompanied by noises Almost all the reports come from a belt of country about three hundred miles wide, lying roughly along the auroral zone, the belt includes the Klondike region, where is situated the township of Dawson, with a population of several thousand, several reports come from this neighbourhood The only other places along the auroral zone, likely to afford such favourable fields of inquiry, appear to be near Churchill, on Hudson Bay, the extreme south of Greenland, Iceland and the most northerly part of Norway

Since very low auroræ seem to be very rare and to be confined to localities near the auroral zone, it is perhaps not surprising that Størmer, Vegard, and Krogness should have observed no such case, or that the Polar Year (1882–83) failed to provide evidence establishing their existence, with the better organisation of auroral observation which it is hoped to achieve during the proposed new Polar Year (1932–33), there is more chance that opportunities of critical examination of these appearances will occur

These low auroræ must obviously be very different in character from those observed in the upper atmosphere, though connected with them Inability to understand their physical nature is not a sufficient ground, in the present state of knowledge, for rejecting the possibility of such occurrences, such an attitude would, for example, forbid acceptance of the reality of globular lightning The observations cited by Mr Johnson constitute at least a case for active further inquiry, and render it highly desirable that auroral investigation near the auroral zone should include not only visual and photographic observations, but also atmospheric electric registration at a well-equipped observatory

Science Medals of Great Britain, Ireland, and the Dominions

AS a supplement to the issue of NATURE of Nov 15, 1930, we published an article on medals awarded for scientific achievement, and brief classified statements relating to the various medals in the gift of institutions of the British Empire The difficulty of making the list exhaustive was obvious, and we print below particulars of further awards to which our attention has been directed

I GENERAL

Royal Society of Western Australia, Perth

Society's Gold Medal—Arising from the commemoration of the centenary of birth of Lord Kelvin, in 1924, the Society decided to institute a gold medal for award from time to time for distinguished work in science connected with Western Australia The entire initial cost was borne by voluntary subscriptions The award is made on a recommendation by a medal committee of five members, and normally at four-yearly intervals The first allotment was in 1925, to Dr W J Hancock, for pioneer research in radiology, that for 1929 was given Dr E S Simpson, government mineralogist and analyst The obverse of the medal bears the bust of Lord Kelvin

Royal Numismatic Society of London

Society's Medal—Founded in 1883, and awarded annually or otherwise in silver or bronze for distinguished services to numismatic science, the recipient may be of either sex, and there is no restriction as to nationality The first allotment was made to Charles Roach Smith, the eminent antiquary, that for 1930 to Mr P H Webb, president of the Society

British Numismatic Society

Saltus Gold Medal—Founded in 1910 by Mr John Sanford Saltus, of New York, a vice-president Awarded triennially to " the member of the Society whose paper or papers appearing in the Society's publications shall receive the highest number of votes from the members, as being in their opinion the best in the interests of numismatic science " Allotment was made in 1929 to Mr J S Shirley-Fox

University of Melbourne.

David Syme Research Medal and Prize—(Mr E O Hercus, 16 Melbourne Place, Cambridge, directed our attention to the omission of this prize Strictly, the original series comprised the awards of medals made by scientific academies and societies, but the following account will be of interest.)

Founded by the gift of £3000 by David Syme for the purpose of encouraging in Australia the carrying out of research work in biology, chemistry, geology, and natural philosophy The award takes the form of the annual bestowal of a gold medal and gift of £125 for a thesis based upon original work in the departments of science mentioned above, but preferably in connexion with the material and industrial development of Australia The thesis must either have been published not more than two years before an allotment, or published afterwards in such a manner as shall satisfy the council The prize is open to any person who has been resident in Australia for not less than five years out of the seven years immediately preceding that in which the prize is offered No professor in an Australian university and no head of a scientific department under any Australian authority is eligible

II PHYSICAL AND MATHEMATICAL SCIENCES

Institute of Actuaries

Institute Gold Medal—In 1920 it was decided to establish a gold medal in recognition of any paper or treatise of outstanding originality in actuarial science, the award not to be restricted as to nationality or sex

N B—No award of this medal has been made so far, but it should be mentioned that in 1927 and in 1929 special gold medals were struck, and bestowed respectively upon two distinguished exponents of actuarial science

British Astronomical Association

Walter Goodacre Gold Medal—Founded in 1929 through a fund provided by Mr Walter Goodacre, a past president, and for award to members in recognition of contributions to the progress of astronomy, special regard being paid to work communicated to the Association An award is made at intervals of not less than two years nor more than four years The first allotment was made in 1930 to the Rev T E R Phillips

Institution of Civil Engineers of Ireland

Mullins Medal—The Institution awards medals (or premiums) annually under the terms of a bequest by Mr M B Mullins, president in 1859–61. The medals may be of gold or silver, and refer in bestowal to meritorious papers read before the Institution The obverse of the medal bears the head of Mullins

Institute of Fuel

Melchett Medal—Inaugurated in 1930 by Lord Melchett, founder-president (1927) of the Institute, to mark the completion of his period of office, for annual award It is struck in bronze, and awarded to such person, whether a member of the Institute of Fuel or otherwise, as in the opinion of the council has done either original research or professional, administrative, or constructive work of an outstanding character involving the scientific preparation or use of fuel, provided the results of such work have been made available within recent date for the benefit of the community The allotment is without restriction as to the nationality of the recipient The first award was made to Dr Kurt Rummell, principal of the Warmestelle, Düsseldorf It is the intention of the council to invite the recipient each year to give a Melchett lecture, following the presentation of the medal

Society of Glass Technology, Sheffield

Frank Wood Medal.—In 1919, the Society, in order to commemorate the services of Mr. Frank Wood, who was the first president, to the glass industry and glass technology, inaugurated a fund and decided to found a medal in bronze; the award to be placed in the gift of the University of Sheffield, and allotted annually to students in the Glass Technology Department. The University holds the fund as trustee. The design of the medal was entrusted to Mr. P. Metcalfe, Royal College of Art, South Kensington.

British Horological Institute

Institute's Gold Medal.—The Institute was established in 1858. In 1928 a gold medal was founded for annual award, at the discretion of the council, for the greatest advance in the science of horology, or some achievement of outstanding merit beneficial to the science or practice of time measurement. The first recipient was the Astronomer Royal, Sir Frank Dyson. The reverse of the medal carries the inscription: "For having improved horology by practice and enriched it with learning."

British Institute of Radiology

Silvanus Thompson Medal.—Founded in 1918, in association with a memorial lecture, and in commemoration of Prof. Silvanus P. Thompson, F.R.S., the first president of the Röntgen Society. Distinguished workers in radiology or allied subjects, of any nationality, may be invited to deliver the lecture, and, so far as possible, choice falls alternately on a medical and a non-medical man. The medal is struck in bronze and bears the bust of Thompson. An honorarium is attached to the lectureship.

Mackenzie Davidson Medal.—Founded in 1920, in association with a memorial lecture, and in commemoration of Sir James Mackenzie Davidson, a pioneer in British radiology. Distinguished workers in radiology or allied subjects, of any nationality, may be invited to deliver the lecture, and, so far as possible, choice falls alternately on a medical and a non-medical man. The medal is struck in bronze, and bears the bust of Mackenzie Davidson. The regulations provide that the choice of lecturer shall be made each year by a joint selection committee appointed by the Institute and the Electro-Therapeutic Section of the Royal Society of Medicine. An honorarium is attached to the lectureship.

Society of Radiographers, London

Reid Medal.—Instituted as a memorial of the services of Sir Archibald Reid. Struck in silver, it is awarded annually in competition amongst members of the Society for radiographic films of merit, applicable to selected subjects which are chosen by the council. The obverse of the medal bears the bust of Reid.

Australian Chemical Institute, Sydney

Smith Memorial Medal.—Founded in 1929 to perpetuate the memory of Henry George Smith, one of the foundation officers of the Institute and a pioneer in research into the chemistry of the Australian eucalypts. The leading Australian scientific societies were represented on the memorial committee, and contributions to the fund were received from each State in the Commonwealth. It is struck in bronze, and awarded annually to that person who has, in the opinion of council, contributed meritorious service to the development of chemical science. The first allotment (1929) was made to Dr. A. C. D. Rivett, of Melbourne, for research work published during the ten preceding years.

Rennie Memorial Medal.—In the course of 1930, members of the Institute established a fund to found a bronze medal in memory of Dr. Rennie, Angas professor of chemistry in the University of Adelaide for more than forty years. He was actively associated with the formation of the Institute, and at one period was its president. It is proposed to award the medal annually, among the younger members of the Institute, for research work.

III. Biological Sciences (including Geology and Geography)

Royal Society of Tropical Medicine and Hygiene

Chalmers Memorial Gold Medal.—Founded in 1921 by Mrs. Chalmers, widow of Dr. Albert John Chalmers, author of numerous works on tropical medicine and hygiene, and student of the hygiene of the tropics. The award is made biennially, and bestowal is in recognition of research of outstanding merit contributing to the sciences of tropical medicine or tropical hygiene. There are no restrictions as regards nationality, sex, or profession. The medal bears on the obverse the head of Dr. Chalmers; on the reverse a representation of *Anopheles costalis*, and below, a spray of the cinchona plant. The first award was made in 1923 to M. Roubaud, Pasteur Institute, Paris.

Manson Medal.—A fund had been subscribed in 1921 by friends and admirers of Sir Patrick Manson, in all parts of the world, with the view of obtaining a memorial portrait. A balance in the fund being available, a bronze medal was founded in memory of Manson's fruitful work and influence in the field of tropical medicine and hygiene. The capital sum, with the allotment of the medal, was vested in the council of the Royal Society of Tropical Medicine and Hygiene. An award is made triennially to the living author of such original work in any branch of tropical medicine or tropical hygiene as may appear to be deserving of the honour. There is no restriction as to the age, sex, profession, or nationality of the author. The obverse of the medal bears the bust of Manson. The first recipient was Sir David Bruce; the last (1929), Sir Ronald Ross.

Royal Army Medical and Allied Services

North Persian Forces Memorial Medal.—In 1921 a fund was raised by certain officers of the Royal Army Medical Corps and Indian Medical Service who took part in the withdrawal of the North

Persian Forces and their subsequent dissolution Struck in silver, a medal is awarded annually for the best paper on tropical medicine or hygiene published in any journal during the preceding twelve months by a medical officer, of less than twelve years' service, of the Royal Navy, Royal Army Medical Corps, Royal Air Force, Indian Medical Service, or of the Colonial Medical Service A Memorial Committee determines the attainment of a standard of merit The first award was made in 1923 The recipient for 1929 was Capt H W Mulligan, Indian Medical Service

Obituary.

DR ALFRED P MAUDSLAY

ALFRED PERCIVAL MAUDSLAY passed away peacefully in his sleep on Jan 22, in his eighty-first year, at Morney Cross, near Hereford Born on Mar 18, 1850, at Lower Norwood Lodge, he attended first a boarding school at Tunbridge Wells and then went to Harrow He was keen in all forms of sport, particularly fishing, and shot for his school in the winning team for the Ashburton Shield Leaving school, he proceeded to Trinity Hall, Cambridge, of which he was made an honorary fellow in 1923 A visit to the West Indies was made in 1872, and from Panama and Guatemala he went north to San Francisco, on his way to New York, and there met his future wife, a daughter of Governor Morris of Old Morrisania, New York The following year, accompanied by his brother, he visited Iceland, making the ardous trip round the island, but he also tells of many pleasant days fly fishing

After taking his degree in 1875, Maudslay went to Trinidad, where he accepted his first appointment as private secretary to H E the Governor He next acted in a similar capacity to the Governor of Queensland Joining the staff of Sir Arthur Gordon as private secretary, he went to Fiji, becoming in turn Acting Colonial Secretary to Fiji, Deputy Commissioner to Tonga and Samoa, and Acting Consul-General for the Western Pacific In 1876 he accompanied Lady Gordon to New Zealand, where he spent some months, crossing into the then prohibited Maori Territory Returning to Fiji, he went to live on Tonga as Deputy Commissioner He left these Pacific islands in 1879, but it was only last year that he published a delightful autobiography of that period in "Life in the Pacific Fifty Years Ago"

Maudslay in his visit to Guatemala was so struck with the Maya ruins he had seen there that he decided to give up his diplomatic career and devote his life to exploration in Central America To that country and Mexico he made at least seven expeditions, visiting, clearing, measuring, photographing, and plotting all the then known Mayan ruins, and the results of these expeditions appeared in 1889 in the "Biologia Centrali-Americana Archæology" By this monumental work he laid the foundation of Maya research, which has since been enthusiastically taken up by German and American scholars This, unfortunately, cannot be said of Great Britain, his priceless collection of 'squeezes' and moulds (which had cost him £10,000) he presented to the nation, but they lay neglected, falling to pieces and eaten by rats, for upwards of thirty-five years in the vaults of the South Kensington Museum, until they were rescued in 1923 by Capt Joyce on behalf of the British Museum There they were pieced together and restored, and casts made and set up in a room to themselves, as they deserve, and now form the finest collection of Maya casts in the world There is an interesting and well illustrated account of these casts compiled by Dr Maudslay and Capt Joyce Maya expeditions to British Honduras, under the direction of the British Museum, have gone out annually since 1926, but the lack of public interest has made expenditure a first consideration, and were it not for the generous help of a few private individuals who supplement the small British Museum grant, it is doubtful if many more expeditions can go out without the help of the United States

When Maudslay made his seventh expedition to Central America, he was accompanied by his wife, and the result was the joint publication of "A Glimpse at Guatemala" in 1899 This charming and beautiful book is printed on hand made paper and profusely illustrated with photogravures, coloured plates, and chromo-lithographs The next work from his pen was a translation, with introduction and notes, of Bernal Diaz' "The True History of the Conquest of New Spain" for the Hakluyt Society, and it ranks among the finest of that Society's publications

In the summer of 1912, the eighteenth International Congress of Americanists met in London under the auspices of the Royal Anthropological Institute, when Maudslay was president, and when the Congress visited Oxford the honorary degree of D Sc was conferred on him for his contributions to Mexican and Mayan archæology Cambridge also honoured him by conferring on him the honorary degree of Sc D

In 1915 Maudslay was one of the joint secretaries of the Royal Geographical Society, in which he took a keen interest, specially at the time when the Society moved from its cramped quarters in Savile Row to Lowther Lodge In 1928 Maudslay published a popular edition of "The Discovery and Conquest of Mexico", with introduction and notes

It was in 1905, in Mexico City, that the present writer had the pleasure of first meeting Dr Maudslay, at a luncheon at the British Legation, sitting next to him, the conversation naturally turned on archæology, and, mentioning having visited the ruined cities of Ceylon, he said it was just 'a toss up' whether he had gone to Ceylon or Central America to excavate Immediately after luncheon

we went to the National Museum, he was very proud of his post as honorary professor of archæology there, and pointed out Maya sculptures which were wrongly labelled as Zapotec A few years later, after visiting the ruins of Palenque with the Mexican Government expedition, and remarking that it took us three days to reach them from Frontera at the mouth of the Usamacinta River, he smiled and said it had taken him nearly three months!

Throughout all his Central American travels, Maudslay seems to have been endowed with extraordinary patience and perseverance, and this, together with his charm of manner and personality, enabled him to overcome all obstacles, whether of local politics, native prejudice, lack of guides, transport or labour Maudslay always gained his point and got his way To the young archæologist he was always ready with help, advice, or encouragement, especially in the study of Maya glyphs, and it is difficult to speak in measured terms of his loss to the Mexican and Mayan student of archæology Those whose privilege it was to be numbered amongst his personal friends will perhaps best remember him for his kind and gracious disposition, his keen and sparkling eye, and his blameless life He was the type of the true English gentleman and traveller We shall not look upon his like again J C C

Mr David T Jones, C B E, chairman of the Fishery Board for Scotland, who died in Edinburgh on Feb 4, in his sixty fifth year, began his official career as a junior clerk in the Fishery Board in 1887 He was promoted after five years' service to be chief clerk, and in 1909 to be secretary to the Board During the War, he served as Paymaster Lieut-Commander, R N R, prepared a census of fishermen, and organised a fleet of fishing vessels for various patrolling and defensive purposes His special knowledge of fishermen and fishing interests, extended by this war service, was of great value in his subsequent administrative work In 1920 he was appointed chairman of the Board He was especially interested in the fisheries problems of the North Sea, and was one of the British representatives on the International Council for the Investigation of the Sea His strong support of the Scottish Fishery Board's scientific investigations is evidenced by the expansion of the laboratory facilities for this work under Dr Alexander Bowman in Aberdeen Mr Jones was of cheerful temperament, and was a very genial friend who will be missed in many circles, especially in Edinburgh

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Mr Thomas Hebden, of Keighley, who died on Jan 3, at the age of eighty-one years, was one of the Yorkshire naturalists who, in the intervals of a business life, devoted himself to a particular branch of botany He was a correspondent with many of the leading lichenologists of his day, and this correspondence was maintained almost up to the day of his death and is reflected by the numerous references to Hebden in lichenological literature His correspondence with Nylander added several species of *Verrucaria* to the British flora, these being published under the joint names of Shackleton and Hebden in the *Naturalist* of 1892 His herbarium and scientific books have been bequeathed to the museum of his own town

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We regret to announce the following deaths

Dr Alfred Holt, one of the joint honorary secretaries of the British Association at its meeting in Liverpool in 1923 and founder of the firm of Holt, Thompson and Co, Ltd, manufacturers of fine chemicals, on Feb 15

Prof F J Pritchard, plant physiologist of the U S Bureau of Plant Industry, who specialised in breeding disease resisting varieties of tomatoes, on Jan 13, aged fifty six years

News and Views

The president of the Russian Academy of Sciences, Dr A P Karpinsky, the distinguished geologist, is leaving his post at the Academy This decision is the outcome of his unsuccessful protests against the recent forced decision of the Academy to deprive of its membership four academicians, including such historians as S F Platonov and E V Tarle, whose scientific views have been pronounced by the authorities to be incompatible with their presence in the Academy of a communistic State It is noteworthy that at the same meeting of the Academy several foreign scientific workers were elected as foreign members It appears clear, in the circumstances, that the acceptance of membership of the Academy of U S S R must involve silent agreement with the basic principle underlying the attitude of the Soviet authorities towards science According to this principle, science is regarded as merely a means to the successful accomplishment of the Five Years' Plan, and scientific workers themselves are forbidden to express, or even to hold, independent scientific views

New Zealand has its Scenery Preservation Act, now almost twenty three years old, and still we wait to see what a British Government Commission will say about the desirability of doing something for British scenery In New Zealand the Act has worked well, as is shown by the Annual Report for 1930, a blue-book of 30 pages, with many photographs and a map in colour, issued by the Department of Lands and Survey During the year, proclamations were made setting land apart for scenic or historic reserves to the extent of 6982 acres, and these areas now bring the number of scenic reserves in the Dominion up to 851, with a total area of 511,792 acres The value of the reserves to the artist and traveller, as well as to the naturalist, is indicated in an appendix by Dr L Cockayne and Dr E Teichelmann, describing the Glacial Scenic Reserves of Westland Apart from the annual interest on the capital expended in purchasing the reserves, the accounts show that they are run for about £1276 a year, and this is offset by rents, etc,

amounting to £757 The annual interest on the invested capital is a more serious drain, amounting to £8979, for with the year's purchases the capital itself stands at just over £200,000

Anything that will lead to uniformity in the mode of reference to periodicals is to be welcomed, and even more important than uniformity is intelligibility An "International Code of Abbreviations for Titles of Periodicals", just issued by the International Institute of Intellectual Co operation ("Physician, heal thyself!"), has both merits Most wisely it is based on the rules and principles adopted by the compilers of "World List of Scientific Periodicals (1900–1921)", and differs little from them Those rules were not easily accessible, even though the British Association Committee on Zoological Bibliography reprinted them (Leeds, 1927) and circulated them to zoological periodicals The present statement, in French and English, is more clearly drawn up, and is obtainable from the Institute for 2 50 fr Intelligibility must be judged, not by the reader thoroughly familiar with the periodical in question, but by the worker in another branch Excessive contraction is therefore to be avoided it should be possible for the educated non specialist to reconstruct the abbreviated word Judged thus, some of the contractions proposed seem to "curtail the already curtailed cur" We jib at "Tms" for the *Times*, "Chi" might mean Chile as well as Chicago and who will guess "L B"? Diacritical marks should be avoided for the sake of the printers, and so we approve of "Kbh" instead of the perhaps more intelligible "Kjøb", but we object to "Ž" for "Žurnal" We could say more, but we prefer to commend this attempt to editors and authors

Cerebro spinal or 'spotted' fever has been somewhat prevalent this year, and the outbreak is the subject of a circular recently issued by the Ministry of Health This disease occurs, to some extent, every year, but in certain years the incidence may be considerably above the average After the War, when it was prevalent, the number of cases declined to 301 in 1923, since when there has been an upward trend, with 666 cases in 1930 in England and Wales This year 230 cases among civilians have been notified, about half of which have proved fatal The cases have been scattered and distributed in 36 counties, with some concentration in the West Riding of Yorkshire The disease is especially liable to attack children and young persons, and during periods of prevalence the responsible micro-organism (the meningococcus) is to be found in the nose and throat of a number of persons who are and remain well Such healthy carriers are probably of more importance than the cases themselves in spreading the disease One factor known to favour local outbreaks is overcrowding in barracks, institutions, and schools Plenty of space should be provided in dormitories, with thorough ventilation

Universities in their relationship to national and international movements are discussed in *Bulletin* No 7, 1930, pp 43, of the Paris office of the Carnegie Foundation for International Peace It contains two papers by Prof d'Irsay, of Johns Hopkins University, and Prof Bloch, of the Sorbonne, entitled respectively "Histoire Internationale des Universités", and "La Cité Universitaire de Paris" Prof d'Irsay concludes his historical survey with a generalisation contrasting the spirit in which their teaching work is conducted by universities with that of their scientific research the former inevitably nationalistic and tending to become monotonous and reactionary, the latter, which is slowly but surely becoming their dominant note, genuinely international and all the more important in virtue of the fact that scientific research is the only real force uniting the world Prof Bloch's paper gives an account of the aims, organisation, and present position of the Cité Universitaire, inaugurated in 1924, when buildings providing for the accommodation of 300 French students were begun Since then hostels have been erected on the Cité estate for Canadian, Belgian, Argentine, Japanese, American, and Indo-Chinese students, and others are in course of construction for British, Swedish, Dutch, Spanish, Armenian, Danish, Greek, Cuban, Monacan, and French provincial students By 1933 the total number of rooms will be 2500 In order to promote friendly intercourse between the students of different nationalities, a "Maison Commune", for which Mr J D Rockefeller has constituted a foundation of 90 million francs, will provide communal refectories, lounges, music room, library, gymnasia, etc, and a medical service

On Feb 25, Mr W G W Mitchell gave a lecture on "Developments in Television" before the Royal Society of Arts He pointed out that early experimenters in the field of television were handicapped through not having suitable photoelectric cells for converting changes of light and shade into corresponding electrical impulses, and also through the modern valve amplifier then being unknown But the past five years have shown that a primitive form of television is physically possible The fundamental difficulties were considered in detail As examples of the trend of development Mr Mitchell dealt with the recent demonstration of two way television in America, the various attempts made to produce a large screen picture suitable for viewing by large audiences, and the attempts that had been made to overcome purely mechanical methods by using electrical ones The American Telephone and Telegraph Co, which was responsible for the two way television system, was primarily seeking information as to the value of the addition of sight to sound in personal conversations over the telephone The extra apparatus for providing vision is bulky and the operating costs are heavy, but work is in progress to reduce these defects Speaking of large screens, Mr Mitchell referred to a recent demonstration by J L Baird of an arc lamp the intensity of which was modulated directly by a vision signal Very good brilliancy was obtained on a screen 7 ft by 3 ft at 10 ft distance by optical projection Purely electrical methods of television, such as the cathode ray method, will be more widely used as soon as the high voltages required for operating can be reduced Mr Mitchell thinks, however, that

the next development will be in the direction of zone methods used in conjunction with wired transmitting circuits Using these methods, it should be possible within a year or two to have a picture of the size and brilliancy of the cinema screen picture of to day

THE presidential address of Dr W H Eccles to the Institute of Physics, delivered last May (see NATURE, June 14, p 894), has recently been published He took as his subject the influence of physical research on the development of wireless communication From the historical point of view the address is of great value, as no one has studied more closely the development of this industry, and in addition no one else has been in personal contact with so many of the pioneers He points out that in the near future the knowledge, which has been laboriously accumulated, of the effect of atmospheric conditions on radio communication, will be utilised and that further rapid developments will take place Radio has advanced practically by leaps and bounds Some of these leaps—for example, the maturing of the triode valve—have led to the scrapping of equipment before it has earned the cost of its engineering development Industrialists naturally fear these revolutionary improvements, due often to physical research At present there is much discussion in engineering circles on rationalisation, the main object of which is to reduce the costs of production and eliminate waste in basic industries Standardisation is a useful help in this direction, and so also is the modernisation of plant and products by the introduction of the latest methods and inventions The standardisation that asks all manufacturers of certain articles to work to agreed specifications concerns engineers only, but that which calls a halt to the introduction of innovations affects physicists also This latter form of standardisation is in conflict with the principle of modernisation Physicists are often looked on askance by engineers, as their revolutionary ideas necessitate changes in manufacture As, however, they live in the laboratories whence spring the discoveries which may overturn the established order, they are admirably qualified to forecast probable developments, which will enable engineers to decide when to standardise and when to modernise

THE January number of the *Brown Boveri Review* gives an interesting record of the progress that is being made abroad in the design of electrical machinery It shows clearly that in electrical traction the advances being made are in the direction of single phase and direct current working The Simplon Tunnel, for example, has been operated for nearly twenty-four years by means of three phase current Since 1920 it has been operated by seven locomotives, which handled without difficulty the greatly increased passenger and goods traffic after the War At the beginning of last year, three phase operation was replaced by single-phase operation, the double type of current collector employed eliminating many difficulties Devices are now employed which enable the locomotives to run at four economical speeds The Italian State Railways are electrifying a number of their sections with high pressure direct current at 3000 volts The electric power is conveyed to the substations at 60,000 volts three-phase, and is then converted into direct current power at 3000 volts by 2000 kilowatt mercury arc rectifiers The design of these rectifiers is being continually improved and their size is rapidly increasing The latest design is a high power rectifier with eighteen anodes capable of supplying a direct current of 12,500 amperes Successful investigations as to the possibility of reversing the action of these rectifiers have been made It is now possible to supply electrical energy from a direct current network to a three phase network The frequency of the supply is the same as that of the three-phase generators, or it can be adjusted to any desired value from the direct current side It can be used for transferring energy from an alternating current system working at one frequency, to another working at a different frequency

THERE seems to be a need for standardising the airway beacons that are used for guiding aeroplanes at night In a paper in the *Illuminating Engineer* for February, H N Green states the requirements that a good beacon has to fulfil, and draws instructive curves to illustrate the light distribution from beacons of various candle powers A beacon has to indicate, either by flashing, or by its colour, or by subsidiary lights, its locality on the route on which it lies When flying at night over inhabited country at a height of 3000 feet, with average visibility a large number of lights can be seen These lights can be divided into two groups Local lights such as street lamps and shop windows form the first group They cease to be visible at a range of from five to six miles The second class contains the high powered head lights on motor transport These sometimes give beams of 50,000 candle power, which are visible at distances up to twenty miles The presence of these flashes occasionally makes it difficult to identify a white flashing beacon when it is more than five and less than twenty miles away The true horizon is about seventy miles distant, and if the beacon lies between twenty and seventy miles away it appears as an isolated flashing light and is easily identified It is suggested that the lower limit for the intensity of a beacon should be 100,000 'beam' candles The author discusses how the visibility varies with the height of the aeroplane and with the state of the atmosphere He makes a calculation to show the worst visibility at which flying is possible Pilots often complain that present day beacons are conspicuous in clear weather, when they are not much wanted, and disappear in bad weather, when they would be of the greatest help

AMONG recent donations received by the Zoological Department of the British Museum (Natural History) is a large album containing photographs taken in the Birunga mountain district to the north east of Lake Kivu, East Central Africa, and dealing with the home of the eastern gorilla (*Gorilla gorilla beringeri*) These photographs were taken and were presented by Mr Marius Maxwell, author of "Stalking Big Game with

(*Continued on p* 377)

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Reviews.

A Trilogy of Science

The Torch-Bearers By Alfred Noyes Vol 3 *The Last Voyage* Pp ii + 229 (Edinburgh and London William Blackwood and Sons, Ltd, 1930) 7*s* 6*d* net

THOSE who remember the interest with which we greeted the first volume of Mr Noyes' "Torch Bearers" seven years ago will understand the satisfaction with which the concluding portion is now received This is all the greater because the third volume is certainly the best from the artistic point of view It contains one well conceived and highly interesting incident, around which the author's pictures of the past and incidental lyrics are effectively grouped, and it leads up to a full and eloquent exposition of the religious synthesis with which the history of science inspires him

It will be recalled that the governing idea of the trilogy was to present the history of science as a connected whole, but, in view of the immensity of the subject and the need of some dramatic interest for poetic purposes, to select certain crucial moments and treat them with some fullness In this way the first volume was made to turn largely round Galileo and Herschel and the second round the Darwinian controversy The third has the advantage of a real incident in contemporary life as its central thread A child on an ocean liner has to be operated on during the voyage There is no first rate surgeon on board, but communication is set up by wireless with another steamer, also in mid-ocean, on which one of the greatest experts happens to be sailing The ship's doctor carries out the operation, under the directions of the other man, but the poet, as he reflects on what is going on, hears other voices, transmitted not only through space but also through time The thought which is co-operating in the attempt to save the life of the child is really that of all the workers and thinkers in the world who have contributed to the skill and knowledge now put forth Harvey speaks and Pasteur Even the Chinese, whose culture of the silk worm had a part in Pasteur's discoveries, find a place

This is the true lesson of the poem, as it is of the growth of science itself

> All this inter dependent, intricate web,
> The invisible system of ethereal nerves,
> Connecting mind and hand with waves of will,
> Without which both were helpless, *whose are they?*

And the answer includes not only Gilbert, Galvani, Ampère, and all workers in physical science, "thousands of men, like cells in one organic brain", but also the still greater host who have worked at the sciences of life

It is a dramatic idea of the highest imaginative value, thus to represent all this collective wisdom and will coming invisibly through the darkness to the cabin of a mighty modern ship to save the life of one small child and it becomes a tragedy, when the child dies Herein Mr Noyes is faithful to the best canons of art The human spirit, like the hero of ancient Greek tragedy, in such a case rises to the height of its powers, struggles to achieve its end, and is foiled by fate Our admiration is by no means lessened, but touched, as Aristotle would have it, by awe and pity

Mr Noyes, however, goes further than the Greek tragedian or philosopher, in attempting to reconcile the failure of the particular action with the reasonableness and rightness of the whole The poet, musing again after the child's death, discovers, after death had struck down the mortal body and the dear thing had vanished from the world which but half an hour ago had "outvalued all earth's kingdoms", that something else is needed to restore his sanity and his acceptance of the universe This is the assurance which then comes to him from the infinite that there is a law and a love which will harmonise all catastrophes, and an eternal memory of which our human fragments are but parts The

latter portion of the poem thus becomes a religious rhapsody, rather on Wordsworthian lines

This concluding volume of the trilogy confirms our impression of seven years ago that Mr Noyes has conferred a signal service both on English poetry and on science The thing is beautiful and interesting in itself, and is bound, especially when it appears in one volume, to attract a large number of serious readers who would otherwise never connect the thought of science with that of poetry It does this also in a novel way, not dreamt of by earlier poets, such as Wordsworth and Shelley, who hoped for an infusion of science in the language and images of poetry Mr Noyes turns rather to the idea of filiation which has become dominant in the last hundred years, and follows it out in certain episodes in the history of science, which is the field where it is best displayed

Mr Noyes' dramatic method of seizing striking incidents in the lives of men of science is the best calculated to rouse popular interest, though it has the disadvantage, from the philosophical point of view, of throwing into unfair relief certain persons, such as Francis Bacon and Renan in the present volume, whom the author chooses as foils for his heroes But how, one may ask in palliation, does Julius Cæsar fare at the hands of Shakespeare, or Cromwell or Louis XI at the hands of Scott ? Let us be thankful for an art which makes vivid for us the clash of personalities in the past and, in Mr Noyes' case, of personalities in a sphere hitherto scarcely touched by poets, and, as history, treated as a thing apart In an age of specialism, when a synthetic spirit is the thing most needed, alike in politics and in thought, what could be more useful than to bring, as Mr Noyes has done, poetry and history and science together in a careful, interesting, and at times very beautiful piece of work ?

F S MARVIN

Vitalism and Mechanism

The Nature of Living Matter By Prof Lancelot Hogben Pp ix + 316 (London Kegan Paul and Co, Ltd, 1930) 15*s* net

SEVENTY years ago, the then small educated public read Darwin's "Origin of Species" with such avidity that its first edition of 1250 copies was sold out on the day of publication For twenty years from that date, biology, because of its obvious and direct bearing on the problem of man's place in Nature, was read and discussed by the general public That continued interest was in large part due to the controversial vigour and literary ability of Prof T H Huxley, but it was based on that aspect of the human mind which seeks an explanation of the apparent purposelessness of the universe and of human life with its joys and sorrows, distributed so capriciously and unfairly This interest, long continued, died away, and has never been revived But in its place has risen an interest far more widely spread and much less easily understood, in those modern developments of physics which depend on the relativity and quantum theories

That modern physics should have excited such popular enthusiasm is due to the literary artistry of Sir James Jeans and Sir Arthur Eddington They have explained, in simple language, results which can only be reached through that particular form of logic which is mathematics But the climax to which this interest has risen since Eddington accepted the Principle of Indeterminacy, and as a corollary passed on to human behaviour and 'free will', shows that it rests on the same basis as the earlier vogue of biology, on religious 'instincts' But, in that mathematicians are animals and that their technique of thought is in fact a phenomenon which falls within the scope of biology in its wide sense, it is certain that there must soon follow an appreciation of the human interest of the philosophical aspects of biology These exist largely in the old controversy between vitalists and mechanists in the new form which it has received from Dr J S Haldane and General Smuts In the book under review, Prof Hogben makes an ardent onslaught on these two writers, with sallies against many another biologist and minor campaigns against Whitehead and Eddington

Prof Hogben's point of view is that no biologist now claims, or will for generations, if ever, be able to claim, that all the phenomena of living things can receive a physico-chemical explanation, but that the only methods which will help to an understanding of the nature of living matter are in their nature identical with those which have proved so successful in the physical sciences He adduces the work of A V Hill and Meyerhoff in illustration of the extent to which the experimental methods of physicists and chemists, with all the fundamental ideas from which these methods arise, can be carried when they are applied to the vastly complex but relatively simple problem of the activities of an isolated but living muscle ' Through that work we have come near to establishing a balance sheet of the energy exchanges which go on in a specific tissue, and have found

no reasons for introducing any conceptions which are foreign to physics or chemistry

Prof Hogben then passes on to an examination of our knowledge of heredity We are entirely ignorant of the nature of the mechanism which determines the course of development of an animal The experimental embryologists have sometimes localised that part of the embryo which, by its presence, initiates and controls the appearance of other parts but of the nature of its influence, whether it depends on the diffusion of chemical substances, on changes in the surface of cells resulting from contacts, or on the establishment of differences of electrical potential, we know nothing There are, indeed, few phenomena of living matter less likely to be expressible in physico-chemical terms than that of hereditary resemblances and differences

Yet by methods which do not differ, except in their form, from those of students of physical science, it has become possible to analyse the varied results of breeding so successfully that a theory has been built up which enables the results of definite breeding experiments to be predicted The prediction is a statistical one, but so are all chemical predictions Prof Hogben gives an admirable account of the evidence and the mode of reasoning which has enabled Prof T H Morgan to establish the theory of the gene, the view that the things which determine the course of development of animals which, when adult, show mutations, are discrete particles, self-reproducing, arranged in a definite linear order in the chromosomes

There remains, however, one field of biology which is still being investigated by methods involving conceptions totally unlike those of the physical sciences The field of the psychologists, conscious behaviour, is still investigated by introspective methods yielding evidence valid only to the experimenter, and interpreted in terms of memory and preferences The school of Behaviourists endeavoured to examine these phenomena by methods less unlike those of chemists, without securing general acceptance for their ideas and methods, but during the past few years the conditioned reflex method of Pavlov has for the first time enabled us to examine the behaviour of a dog, in circumstances which in ourselves would involve consciousness, by methods which do not differ in their fundamental character from those used in ordinary physiological experiment, and are capable of wide extension to other animals The results which have already been reached by Prof Pavlov's own school are of the utmost importance and show that part, at any rate, of the most secure redoubt of the vitalist is open to attack

Prof Hogben is a purist To him no theory can be science unless it can be subjected to experimental substantiation All else, if we understand him right, though it may be true, is not science but some other branch of learning In Prof Hogben's opinion, the characteristic features of scientific theories are that they are established on the basis of evidence which can at any time be reproduced and is accepted by all those who enter into the discussion The discussion itself pays no attention to ethical implications, and is so conducted that personal idiosyncrasies play no part It lies, in the author's phrase, in "the Public world"

But outside this, there are series of private worlds of æsthetics, religion, and philosophy, and between these no agreement can arise by public discussion, because the evidence valid for one man may justifiably not be accepted by another, and each man's view will be determined by his individual peculiarities

Prof Hogben's book should be read by all students of biology for its exposition of a point of view, and for its penetrating criticism of some current biological conceptions It is, as a whole, brilliantly written contains much wit, and some facetiousness, but is badly constructed, containing much repetition It is, indeed, not that organised whole, a work of art D M S W

De Generatione

Early Theories of Sexual Generation By Dr F J Cole Pp x + 230 + 10 plates (Oxford Clarendon Press, London Oxford University Press, 1930) 15*s* net

THIS interesting essay is one of the relaxations that Prof F J Cole has allowed himself in the course of his labours on a "History of Zoology", and we cannot but hope that he may make yet other diversions of a similar nature, provided, of course, that the progress of the *magnum opus* is not unduly delayed Sexual generation is a subject that the inquisitive mind has always been prone to play with, and thus the history is often very picturesque, even grotesquely so This is well illustrated by the persistence with which observers, who should have known better, discerned and designed within the spermatozoon the lineaments of a fœtus

One is glad to find that Leeuwenhoek remains the discoverer of spermatozoa (about 1677), neither Huygens nor Hartsoeker having any share in the honour Mr Ham, of whom Leeuwenhoek speaks, may have assisted but he did not publish Dr Clifford Dobell, who furnishes a translation of Leeuwenhoek's historic letter, points out that it has been through a misinterpretation of words that Haller, with others after him, spoke of Hooke as demonstrating spermatozoa to Charles II's command The minute motile things he demonstrated to the King were infusorians There is often something delightful in the words used by the pioneers thus in the semen of a ram the spermatozoa were seen "moving forwards in a troop with great gravity like a flock of sheep" We know that hundreds of typical spermatozoa may readily move about without jostling in a drop of fluid suspended from the head of a pin, and Leeuwenhoek says, 'I judge a million of them would not equal in size a large grain of sand' As to shape, he compared a human spermatozoon to "a small earth nut with a long tail, and adds "I have sometimes fancied that I could even discern different parts in the bodies of these animalcules but forasmuch as I have not always been able to do so, I will say no more' Later on as Dalyell puts it we descend from the observations of Leeuwenhoek to those of Buffon, and the bathos was reached by Pouchet, who described the alimentary apparatus of the spermatozoon Even within the last hundred years Carus described the œsophagus, stomach, and intestine of the cephalopod spermatophore, and was not the great Kölliker trapped like others into regarding the discharged hectocotylus arm as a complete male animal Very shrewd was the suggestion of Treviranus, that spermatozoa were comparable to "animal pollen', but it was not until about 1841 that Kölliker gave the death blow to the widespread theory that they were parasitic vermiculi "It took over a hundred and sixty years of research to establish that the spermatozoa were not homunculi or parasites with a complex organisation, but tissue elements of the animals in which they were found'

The *pièce de resistance* in Prof Cole's fascinating book is the story of the preformation doctrine, for the first time told in a complete fashion, with the historical scenery that is needed to give a true perspective We are shown that the preformation doctrine, an outgrowth of the Mosaic cosmogony, propounded the extraordinary view that there was no generation in Nature, but only the unfolding of a diminishing series of germs created at the beginning of the world Inside the insect's cocoon there is a preformed insect, only requiring to be unfolded—born but not made At earlier stages there is similar preformation, though it may be too small or transparent to be seen Gaps were filled "by the mendacity of some and the mistaken credulity of others"

How was it that "for over a century the most popular theory of generation involved a denial that such a process actually existed, or that it afforded any scope for original research"? Partly because preformationism fitted in well with a wooden creationism, partly because microscopic research still remained very difficult, partly because attention was preoccupied with a few objects, like the pupa in its case, which suggested a preformed miniature organism, or even, in rare curiosities like *Miastor*, one generation inside another But the main reason for the vicious parenthesis was really that in spite of reawakeners like Vesalius, the scientific mood was still more than half asleep as regards the problems of development What a fine contempt there is in Von Baer's remark (1837) in regard to the theory of *emboîtement* "Although this hypothesis borders on the insane, it has been advocated by very distinguished naturalists, and it affords a striking example of the aberrations into which one can fall if we systematically follow assumption rather than observation

Prof Cole gives the most scholarly account of preformationism that has yet been published it is so perfect that we do not think that any more detail, or setting, or interpretation need be looked for in days to come, especially since the long drawn out absurdity, whether with or without *emboîtement* or encasement, bordered closely on the pathological Of course he distinguishes the *ovism* of Swammerdam, Malpighi, Haller, Spallanzani and Bonnet, who located the preformed fœtus in the ovum, from the *animalculism, spermatism*, or *vermiculism* of, say, Leeuwenhoek, who championed the spermatozoon and to these two forms he adds a third, represented by Prévost, Dumas, and Rolando, who suggested that an imperfectly preformed embryo in the egg or in the sperm is completed by epigenesis But this suggests a cross division of theories

Prof Cole is such a fine historian that we occasionally get a suggestion that his qualities in this direction outrun his biological acumen Thus he arranges the various theories of generation prevalent in the seventeenth and eighteenth centuries as (1) pangenesis, (2) precipitation, (3) semin-

ism, (4) preformation (*Vorbildung*), (5) epigenesis (*Nachbildung*), and (6) panspermy, but this does not strike us as a convincing grouping. Thus, 'precipitation' is a very different *kind* of theory from 'panspermy', which is practically the same as abiogenesis. Again, we do not feel at all convinced that Darwin resuscitated the ancient theory of pangenesis, which accounted for the germ by assuming contributions from all parts of the body. For Darwin recognised the existence of the *sexual elements*, and evidently thought of them not only as receiving gemmules from their bearer's body, but also as receiving them in a dormant state from preceding generations (see 'Variation of Animals and Plants', 1868, vol. 2, p. 402, etc.).

Then again, is there not a risk of confusion in the learned author's suggestion that modern advances are leading us behind a descriptive epigenetic embryography to an explanatory preformationist embryology? For modern genetics is so utterly different from the old preformationism that the use of the old word is almost perverse. Moreover, even the general idea is on another plane, for we think of developmental initiatives liberating other initiatives in a long succession, not of simultaneity of original equipment.

The chapter on fertilisation is a fine piece of work, but its very excellence leads us to suggest for another edition that all these stories of fumbling tentatives would be more educative if they ended, ever so shortly, in a statement of the modern position. Thus we get so much intrigued with early theories of like begetting like that we almost demand Weismann's continuity of the germ plasm, and so with fertilisation. But the book is none the less deserving of being called masterly.

J. A. T.

In Mesopotamia during the War

Loyalties: Mesopotamia 1914–1917, a Personal and Historical Record. By Lieut.-Col. Sir Arnold T. Wilson. Pp. xxxvi + 340 + 28 plates. (London: Oxford University Press, 1930.) 25s. net.

CONSIDERING the never ending spate of books dealing with the multitudinous aspects of the Great War, world wide as it was, with a story in every continent, it is curious to reflect that the struggle in Mesopotamia has had until now no competent historian. Sir Arnold Wilson, who lived and moved and had his being in those epic years in the Middle East, is peculiarly fitted to describe the moving pageant of the War in that theatre, since he, above all others, had the responsibility of making effective the civil administration that step by step followed in the wake of the military arm. By training a soldier—and a distinguished one—by race and instinct an administrator of insight and vision, he is admirably qualified to make clear "a tale of great deeds by land and river, sea and air, of suffering and endurance, and faithfulness unto death on both sides, in pursuit of objects dimly seen, and of aims but darkly understood."

It is the particular genius of the English to be able to implant and nourish the seeds of political organisation and of the broad principles of tolerant governance in whatever spheres they are placed, and Sir Arnold's thesis is, in effect, a dissertation on the creation of the mechanism of administration in a land newly conquered, and amongst a people indifferent, if not at first actively hostile. To readers of NATURE the characteristic impact on affairs of botanists, geologists, bacteriologists, entomologists, hygienists, and chemists is at least equal in interest to the story of the military occupation and the subsequent pacification and orderly organisation. Sir Arnold was quick to see the importance of enlisting every scientific arm into the general service, and hard on the heels of the purely political officer followed men, often with difficulty extricated from the ranks of the forces, whose special aptitudes fitted them for the even more urgent scientific functions in this field. Sanitation, water purification, attack on parasites, bacteriological investigations, geological surveys, siting of quarries, and innumerable other problems of first importance for the health and well being of the great armies in Mesopotamia, were solved by the efforts of this devoted band.

Of the darker side of the campaign the author has, in a characteristically reticent way, conveyed a sufficiently serious message to the nation in particular and to civilisation in general. Mismanagement unhappily is common to all human effort, but never was it more apparent than in the breakdown of the medical service in Mesopotamia, though Sir Arnold pays a notable tribute to the services of Dr. (now Sir William) Willcox in bringing the resources of science to bear on delicate problems of diagnosis and prophylaxis. Quoting from the Report of the Commission in 1917:

"The medical provision ... was from the beginning insufficient. ... By reason of the continuance of this insufficiency there was a lamentable breakdown in the care of the sick and wounded. ... The defects of medical provision caused avoidable suffering to the sick and wounded, and during the breakdown of the winter of 1915–16 this suffering was most lamentably severe."

Even worse is the harrowing story of the survivors of Kut "The scene at Baghaila was one of anguish and misery The march itself (from Kut) was a nightmare The Arab soldiery used sticks and whips to flog the stragglers on Some have been thrashed to death, some killed some left to be tortured by the Arab Every now and then we stopped to bury our dead" 2592 British rank and file left Kut, 1700 died in captivity Such was 'the gentlemanly' Turk, but "The General Staff in Mesopotamia discredited every report of brutality or cruelty till the bitter truth could no longer be hidden" The reviewer has purposely quoted these terrible details of the grimmer aspects of the War to direct attention to a chapter which is written with a restraint and a latent fire that render it one of the most effective exposures of a foolish tradition ever put forward

It remains finally to congratulate the author on the achievement of a living history It would be supererogatory to direct attention to the easy flow of its style, to the wealth of knowledge and sympathy enshrined in it, to the reticence of a man who feels deeply, and felt deeply, in telling and recalling its moving story It is a book that no Briton should fail to read, and in reading, to anticipate with no less interest the sequel that will deal with the later history of the War and the notable and fruitful scientific services in connexion with agricultural and mineral development, aviation, and preventive hygiene A E D

Biological Catalysts

Enzymes By Prof J B S Haldane (Monographs on Biochemistry) Pp vii + 235 (London, New York and Toronto Longmans, Green and Co, Ltd, 1930) 14*s* net

THIS book marks a new departure in the series of Monographs on Biochemistry, additions to which have appeared at intervals since its happy inauguration in 1908, for the subject has already been treated in an earlier volume of the series, Bayliss's "Nature of Enzyme Action" (1908), the last edition of which from its author's hand appeared in 1925 As the present author points out, Bayliss's book was strongly individual and it was rightly thought that an entirely new work would be better than an attempt by an alien hand to bring Bayliss up-to-date Bayliss's main thesis was that enzymes act as colloidal catalysts and combine with their substrates and other substances by adsorption, "so that the action of enzymes in general must be regarded as exerted by their surface", and a large part of his book was devoted to the support of this view In the present work this position is assumed almost without discussion, though it is carefully pointed out that "the assumption that an enzyme molecule activates only one substrate molecule at a time has worked remarkably well"

In the new book, the influence on enzyme action of such factors as enzyme concentration, hydrogen ion concentration, temperature, radiation, and the union of the enzyme with its substrate and other compounds is first considered Then follows a chapter on the course of enzymatic reactions and its mathematical theory, treated with a profusion of mathematics which implies a high, and we hope well deserved, compliment to the attainments of the readers of the book Interesting chapters follow on specificity, coenzymes and other adjuvants, the 'poisoning' of enzymes, and the purification of enzymes, and the work is concluded by a chapter on the theory of enzyme action and classification

Throughout the book a wealth of examples is brought forward, which fully justifies the author's reputation for an encyclopædic knowledge of the literature, but sometimes leaves the reader a little breathless A number of tables are included, in which a great mass of information is usefully summarised

The author, perhaps wisely, avoids generalisations, but it can be gleaned from his pages that he regards enzymes, defined as soluble, colloidal, organic catalysts produced by living organisms, as capable of combining with their substrates, owing to the chemical structure of the latter, and also with at least one of the products of the reaction catalysed In this combination the substrate molecules do not, in general, cover the whole surface of the enzyme The substrate in this situation requires the addition of less than the usual amount of energy increment to enable it to undergo the chemical change in question The reason for this is not definitely known, but the author makes an interesting suggestion, and Quastel's theory of active centres provides another The fundamental question as to the exact structure which renders an enzyme capable of exerting its specific effects has not yet been answered

Biochemists have every reason to be grateful to the author for the abundance of material which he has put before them, and for the careful and logical way in which he has treated it

ARTHUR HARDEN

Birds of Africa and Asia

(1) *Nicoll's Birds of Egypt* By Colonel R Meinertzhagen Published under the Authority of the Egyptian Government Vol 1 Pp xvi + 348 + 19 plates Vol 2 Pp 349-700 + 19 plates (London Hugh Rees, Ltd , 1930) 30*s*

(2) *The Game Birds of India, Burma and Ceylon* By E C Stuart Baker (Published by the Bombay Natural History Society) Vol 3 *Pheasants and Bustard Quail* Pp x + 341 + 20 plates (London John Bale, Sons and Danielsson, Ltd , 1930) 42*s* net

(3) *A Handbook of the Birds of Eastern China (Chihli, Shantung, Kiangsu, Anhwei, Kiangsi, Chekiang, Fohkien and Kwangtung Provinces)* By J D D La Touche Part 5 *Containing Families Motacillidæ, Alaudidæ, Zosteropidæ, Nectariniidæ, Dicæidæ, Pittidæ and Eurylaimidæ* Pp 399 500 + xx + 2 plates (London Taylor and Francis, 1930) 7*s* 6*d* net

(4) *Coloured Plates of the Birds of Ceylon* By G M Henry With a Short Description of each Bird by W E Wait (Published by the Ceylon Government) Part 3 Pp iii + 16 + 16 plates (Colombo Colombo Museum , London Dulau and Co , Ltd , 1930) 30*s*

(5) *Systema Avium Æthiopicarum a Systematic List of the Birds of the Ethiopian Region* By William Lutley Sclater Prepared in conjunction with Special Committees of the British and American Ornithologists' Unions Part 2 Pp iii + 305 922 (London Taylor and Francis, 1930) 21*s*

THE titles above are evidence of the progress being made towards a conspectus of the world's avifauna For one country or region after another, books are steadily appearing which collate, for their respective areas, information which was previously either unavailable or else widely scattered in the ornithological journals in some cases they break fresh ground, while in others they replace older works now out-of-date The particular volumes here to be discussed range from Africa to the Far East

(1) Pride of place must be given to the work on Egyptian birds which Col Meinertzhagen has compiled upon foundations laid by the late Michael Nicoll Unlike the others mentioned, it is issued complete—in two volumes simultaneously published It is also, both in form and content, one of the most admirable bird-books of recent years The volumes are of sumptuous size, well bound, and printed in a manner which leaves nothing to be desired In addition to numerous text-figures and three useful maps, there is a series of photogravures and very beautifully coloured plates excellently reproduced In these circumstances, thirty shillings for the two volumes together must be regarded as an extraordinarily low price

The fine production is justified by the quality of the subject matter Nicoll had been assistant director of the Zoological Gardens at Giza for eighteen years when ill health compelled him to retire in 1924 and led to his death in the following year, at the age of forty five years During that period he had published a " Handlist of the Birds of Egypt " (1919) and had amassed much material for this larger work His task has now been very ably completed by Col Meinertzhagen, who has not only cast the whole into proper form, but also has supplemented the information from his own field experience in Egypt and by further study of the specimens available in Nicoll s collection and elsewhere The result must certainly rank as a very valuable addition to ornithological literature, and it well fulfils the author's desire to provide a worthy memorial to his friend

The bulk of the work naturally consists of accounts of the individual species , these are systematically arranged and provided with useful identification keys A series of appendices tabulates the birds according to their status—the residents, the few summer visitors coming from the south to breed, and the very numerous species from the north and north east that visit Egypt on passage or for the winter

Unlike many authors of such works, however, Col Meinertzhagen is not content with merely systematic treatment of his subject He rightly asserts the necessity for using the data in some approach to general biological problems relevant to the area, and he proceeds to give practical effect to this view in several introductory chapters of much interest The first volume opens with accounts of the physical geography and the geology of the country There follows a brief general dissertation on the theory of evolution, but this does not seem altogether necessary and scarcely does justice to the complexity of that subject The author is on firmer ground when he discusses the origin of life in Egypt There are three principal types of country to be considered The oases, first, are regarded as the relics of a former rain-watered area of wide extent desert, secondly, has largely supervened , and, thirdly, the Nile valley and delta are of still more recent origin In the first and third of these habitats, the

avifauna is mainly of Palæarctic type, but with a strong tropical flavour due to species which have either remained from pre glacial times or have come from the south more recently with the development of the Nile valley On the other hand, the true desert avifauna is considered to have spread from the east

The chapter dealing with migration to, from, and in Egypt is of especial value and raises many points of general interest It includes a section on the difficult questions of sex and age in relation to migration, and of the possible influence of moult Mr R E Moreau contributes a section to this chapter on migration, and also a well illustrated chapter on the birds of ancient Egypt as known from inscriptions, mural decorations, and mummified specimens Finally, there is a chapter in which Col Meinertzhagen deals with practical questions of bird protection in Egypt

(2) Mr Stuart Baker's third volume on Indian game birds, dealing with the pheasants and bustard quail, follows its predecessors after an interval of nine years, a delay possibly due to the author's preoccupation with his greater work on 'The Fauna of British India', of which the eighth and final volume has also recently appeared The present book aims, on one hand at giving a scientific review of the birds which form its subject, and on the other, at providing a useful guide to sportsmen It admirably fulfils both purposes, as was to be expected from an author who is not only a recognised authority on Indian ornithology but also a well known game shot The volume is handsomely made up and well illustrated

(3) With the fifth part of his handbook, Mr La Touche completes his first volume and also his account of the passerine birds of eastern China This work is on a less ambitious scale than those mentioned above, containing, for example, no figures of the species, but it gives adequate descriptions of the birds, as well as accounts of their distribution in the region, and it should serve a useful purpose

(4) Mr Henry's work, on the other hand, consists almost entirely of illustrations The sixteen plates from his brush are of a high order of merit and have been excellently reproduced in colour The object has been to depict a series of birds characteristic of Ceylon The majority of the species or sub species selected are indeed peculiar to the island To each plate there is a brief annotation by Mr W E Wait, to whose "Manual of the Birds of Ceylon" (1925) this work may in some sense be regarded as a pictorial supplement

(5) Mr Sclater's "Systema" is a work of reference in its severest form—invaluable to serious students dealing with African ornithology, but necessarily making no general appeal It is a classified catalogue of the birds of the region, the volume now before us dealing with the passerine birds and comprising more than four thousand forms The author is to be congratulated on the completion of a most laborious task His work bears the stamp of authority and will serve as a base line for further systematic work for a long time to come

It is worthy of note that both Col Meinertzhagen's and Mr Henry's works are published under the auspices of the governments of the countries concerned The same applies to Mr David Bannerman's "Birds of Tropical West Africa", of which the first volume was recently reviewed in these pages Without this support, the publication of such books would often be impossible

X-Rays and their Applications

(1) *X ray Crystallography* By R W James (Methuen's Monographs on Physical Subjects) Pp vii + 88 (London Methuen and Co, Ltd, 1930) 2*s* 6*d* net

(2) *Les rayons X théorie et applications* Par Dr Jean Thibaud (Collection Armand Colin Section de physique) Pp 218 (Paris Armand Colin, 1930) 10 50 francs

(3) *Les applications des rayons X physique, chimie, metallurgie* Par Dr J J Trillat (Recueil des Conférences Rapports de documentation sur la Physique) Pp 298 + 16 planches (Paris Les Presses universitaires de France, 1930) 85 francs

(4) *X-ray Technology the Production, Measurement and Applications of X rays* By Dr H M Terrill and Dr C T Ulrey Pp viii + 256 (London Chapman and Hall, Ltd, 1930) 21*s* net

(5) *Handbuch der Experimentalphysik* Herausgegeben von W Wien und F Harms Unter Mitarbeit von H Lenz Band 24, Teil 1 *Allgemeine Physik der Röntgenstrahlen* Von Fritz Kirchner Pp x + 548 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 55 gold marks

RÖNTGEN'S discovery of X rays at the end of the year 1895 began a new era in the history of scientific investigation Few discoveries have so speedily been followed by important benefits to mankind in connexion with medicine and surgery, and by equally important theoretical advances It is no exaggeration to say that our present knowledge of the structure of the atom dates from 1895,

for not only did the X-rays provide a convenient means of producing ionisation in a gas, but also by their penetrating power they suggested that search for other penetrating radiations which resulted in the discovery of radioactivity. Yet on looking back it seems somewhat strange that there should have been such a long interval—about seventeen years—between the first discovery of X-rays and the introduction of a crystal as a three-dimensional diffraction grating for the analysis of the rays. We may recall the fact that there was a slightly longer interval a century earlier between the invention of the voltaic cell and the discovery of the magnetic action of the current by Oersted. To the intuition of von Laue (1912) we owe the X-ray spectrograph and the marvellous developments which have followed from its introduction by the Braggs and its improvement by other workers.

(1) Mr. R. W. James, who has had experience in Prof. W. L. Bragg's laboratory in the University of Manchester, has written a very good monograph on X-ray crystallography. He has dealt with general methods rather than with their application to particular cases, and in consequence his little book should serve as a useful introduction to the standard works listed in the bibliography. "It is now clear that the type of regular arrangement formerly associated only with definite crystals is characteristic of all true solids, and that the study of crystal structure is really the study of the architecture of matter in the solid state." He begins with a description of crystal form and the space lattice, and then considers the crystal lattice as a diffraction grating. The longest chapter is that on the symmetry of crystals and its determination by means of X-rays.

Natural crystals may be regarded as mosaics of more or less perfect blocks, which, although nearly parallel, may vary in orientation over a small range of angles. If suitable material is available, the size of the unit cell can be determined and the space lattice investigated by examining a large number of spectra and noticing systematic absences of spectra of a general type. It is usually possible to determine also the space group, the scaffolding of symmetry planes and axes upon which the structure is built.

To find the exact positions of the atoms it is necessary to study the intensities of the X-ray spectra, and the extremely interesting chapter on this subject reveals some of the difficult problems with which the investigator has had to deal in interpreting his results and the skill with which these questions have been attacked. "Each crystal is a separate problem, and the success obtained in determining its structure depends largely on the skill and experience of the worker."

In the final chapter, on types of crystal structure, the author considers some of the more noteworthy results of crystal analysis, dealing in particular with simple metallic and ionic crystals, complex ions, the silicates, and lastly, molecular and organic crystals.

(2) Dr. Jean Thibaud has carried out successful pioneer work on the properties of the soft X-rays, having designed a grating spectrograph by means of which he has helped to bridge the gap between the ordinary X-ray region and the ultra-violet. If the grating is calibrated by means of a line in the visible or ultra-violet spectrum, the wavelengths of X-rays can be determined and the grating constant of a crystal can be deduced. Thus the measurements provide an independent estimate of Avogadro's constant and the fundamental electron charge.

In the volume before us, Dr. Thibaud has provided a compact and lucid account of the theory and the applications of X-rays. The book is divided into four parts, the first dealing with X-rays considered as electromagnetic radiations, the second with X-rays as quanta, the third with the technique of the rays and their practical applications, and the last part containing a short account of related rays such as the gamma rays and the 'waves' of L. de Broglie. The volume forms an admirable introduction to the science of X-rays, which, as the author points out, has led not only to deep philosophical speculations as to the structure of matter but also to a long series of technical and industrial applications.

(3) Dr. J. J. Trillat has written a comprehensive treatise on the applications of X-rays in physics, chemistry, and metallurgy, special attention being paid to the more recent developments. The book is divided into two parts of unequal length. In the first part, extending to about one hundred pages, the author deals with generalities necessary for understanding the following chapters. The methods of producing X-rays are discussed at length, and a detailed description is given of the apparatus and methods employed in X-ray spectrography.

In the second part of his work, Dr. Trillat describes the various applications of X-rays in the domain of physical chemistry and in industry. The most significant feature of this part of the book is the great development which has taken place in the application of the rays to the study of organic compounds, including colloidal sub-

stances, cellulose and its derivatives, caoutchouc, resins, gelatins, etc The sixteen plates which illustrate the book are very striking, and show the great advances which have been made in recent years in the technique of the subject

(4) In the volume by Drs Terrill and Ulrey the practical rather than the theoretical aspects of X ray measurements are presented Many of the problems discussed are common to all X-ray laboratories, but particular attention has been given to the quantitative measurements involved in X-ray therapy and in industrial applications The subject has advanced to such a stage that a considerable portion of the contents may be pro perly classified as X ray engineering The book is specially valuable for the practical hints which it contains regarding the construction and use of apparatus, and mention may be made of the descriptions of various forms of tubes and of the precautions to be observed in exhausting them so that they may be sealed off from the pump

The temptation to quote interesting statements is great, but only a few can be given In the highest vacuum attainable to day (about 10^{-4} bar) there are still more than a 'billion' (10^9) molecules in each cubic centimetre A very small part of the energy of cathode rays, only one or two tenths of one per cent, comes out of the target in the form of X-rays Lenard ray tubes have recently been constructed with thin glass windows of about 0 001 cm thickness which can still support atmo spheric pressure The emergent rays can thus be produced at lower voltages than when windows of denser metals are used This book should be of great service in the laboratory

(5) The large volume on Rontgen rays in the "Handbuch der Experimentalphysik" is written by Dr Kirchner, of Munich, and includes the general physics of the phenomena associated with the rays, but not the subjects of X ray spectroscopy and crystal analysis, which are treated in separate volumes The book falls into three parts, the first dealing with the production and measurement of the rays, the second with electron emission produced by the rays and the accompanying phenomena, and the third with the scattering of the rays We have here a very complete account of the subjects treated, including the earlier as well as the more recent researches

Of special interest are the chapters touching upon the Compton effect, in which a quantum of primary radiation colliding with a *free* electron recoils from the impact with diminished energy and therefore lower frequency It is no longer possible to doubt the reality of this effect, now confirmed by so many investigations, and in consequence the classical electromagnetic theory can no longer be considered adequate for the explanation of the relations between electrons and radiation Some form of the quantum theory must necessarily be accepted,

H S Allen

Sound and its Uses

(1) *A Textbook of Sound being an Account of the Physics of Vibrations with special reference to recent Theoretical and Technical Developments* By Dr A B Wood Pp xiv + 519 (London G Bell and Sons, Ltd , 1930) 25*s* net

(2) *Sound Waves and their Uses Six Lectures delivered before a "Juvenile Auditory" under the auspices of the Royal Institution, Christmas 1928* By Dr Alexander Wood Pp x + 152 (London, Glasgow and Bombay Blackie and Son, Ltd , 1930) 7*s* 6*d* net

(1) IN reading acoustical literature, it is, at times, difficult to avoid an impression that the publication of Rayleigh's masterly treatise, 'The Theory of Sound", tended to exert a harmful influence on the subject as a whole Thus, in the preface of the latest text book on sound, we find its author writing "The change which has taken place during the past ten or twenty years in the study of mechanical vibration and sound is my excuse for writing this book when such treatises as those of Rayleigh and Lamb already exist" Since a complete physical theory of a phenomenon is only obtained when mathematical and experi mental work both yield the same quantitative results, the two treatises referred to should never be regarded as treatises on sound, but only as treatises on the *theory* of sound The justification for Dr Wood's book is not merely his description of the recent advances in sound, but rather his skill in giving equal importance to experiment and to theory

Until quite recently, sound suffered from the fact that its mathematical theories had far out stripped experimental technique, which had to wait for the development of the thermionic valve and those electrical instruments of similar delicacy the applications of which are so well described in the present volume Before their appearance, the mathematicians had become too impatient, as can be well illustrated by a particular problem—that of the struck string Helmholtz gave two theoreti cal treatments which were never tested experi mentally Rayleigh felt justified in writing of

them, "Helmholtz has obtained a solution representing all the essential features of the case" Now it is no exaggeration to say that, to correct this statement, "none of" would have to be substituted for "all" The validity of any particular theory of the struck string is of little importance, but it is surely of fundamental importance to realise that quantitative agreement between experiment and theory is an essential test of the validity of any theory The appearance of a correct piece of mathematics in Rayleigh's "Sound" is no guarantee that it necessarily represents Nature's behaviour in the particular phenomenon concerned

Dr Wood's book is thoroughly modern in outlook and covers all branches of the subject with the exception of musical instruments Such subjects as relaxation oscillations and power considerations, which are not found elsewhere, receive adequate attention here Even so classical a subject as the transverse vibrations of strings is thoroughly revitalised by a discussion of the electromagnetic means of excitation, the Dye sonometer capable of measuring or adjusting an electrical frequency with an accuracy of 1 in 1000 over a considerable range, and the latest Einthoven string galvanometer with its string only 1 mm long, stretched in a high vacuum (less than 10^{-3} mm of mercury), and tunable to radio frequencies of the order 3×10^5 cycles per second In the discussion of sources of alternating current, no mention is made of the various gramophone records available for this purpose It is a pleasure to note that in the chapter on technical applications, including the measurement of distance by sound, acoustics of buildings, the gramophone, sound films, and alternating power transmission by the Constantinesco system, four pages are devoted to the problem of noise reduction

Not only is this text-book the best so far produced on its subject in any language, but also, in the skilful blending of theory and experiment and in the careful statement of assumed initial and boundary conditions and factors omitted from a particular treatment, it forms a model of the ideal text book

(2) Dr A Wood's book founded on the Royal Institution 1928 Christmas Lectures is a popular, well illustrated account of sound waves and some of their uses The first lecture on waves introduces no new experiments, and Fig 6 is quite Victorian In the course of the second lecture, dealing mainly with signalling in air and water, data are given of the efficiency of various sound sources, from which it appears that the human voice with an efficiency of only one per cent is one of the best The remaining lectures deal with musical sounds, sound analysis, hearing, and sound recording and reproduction At the end of each chapter is an extensive bibliography, that at the end of Chap vi includes references which show that the gramophone sound-box reproduced as typical in Fig 129 is out-of-date

Although the work is an attractive presentation of interesting facts, it gives nothing more than the facts The uses of sound waves dealt with are chiefly those which would foster the impression that science is 'the hewer of wood and drawer of water' for humanity Too little attention is given to the most important use of sound in the rapid communication of thought, and may we not also include the effect produced upon music lovers by a symphony or a string quartet as an important use of sound? In so hackneyed a subject for popular lecturing, one would have liked to see the facts of the lectures used as propaganda for the cause of pure science, or as a means of demonstrating scientific method, science as a way of thinking and reasoning The discussion of the silent zone in the second lecture, for example, would have served admirably for this latter purpose The publication of such a book as this, a collection of facts, without an index, is unforgivable W H GEORGE

Line and Band Spectra.

(1) *The Structure of Line Spectra* By Prof Linus Pauling and Prof Samuel Goudsmit (International Series in Physics) Pp x + 263 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1930) 17*s* 6*d* net

(2) *Band Spectra and Molecular Structure* By Dr R de L Kronig Pp x + 163 (Cambridge At the University Press, 1930) 10*s* 6*d* net

BOOKS dealing with modern physics can often be divided into two classes Into one category fall those which are conscious throughout of the reader's infirmities (real or imaginary), while in the other will be found those works—full of intellectual honesty—which face the facts and leave the aspirant to strike out for himself as best he may, even though he is certain to meet with heavy weather Such a classification is reasonably well illustrated by the two books before us, into the first group goes the volume by Profs Pauling and Goudsmit, and into the second that by Dr Kronig

(1) "The Structure of Line Spectra" is true to its title, in that the atom receives nearly all the attention The authors frankly state their prefer-

ence for the vector model, and base the whole of their treatment upon it Much space in the early part of the book is occupied by discussions about orbits (in Bohr's sense), followed by the conventional introduction to the simplest application of the wave equation This being so, it is a little difficult to see why we might not have been spared the orbits in their unregenerate guise and thus create more room for enlarging the section on quantum mechanics As it is, the stationary states of the hydrogen atom and the equations describing them on the older quantum theory appear to serve no useful purpose

The following chapters deal adequately with the usual applications of the vector model to alkali-like atoms (with the appropriate extensions), intensities, the Pauli *Verbot*, hyperfine structure, and nuclear moment A decidedly good account of Hund's work on the magnetic moments of ions of the rare earths and the causes of the failure of the theory for the transitional elements will be found in the last chapter This subject is exercising many minds at the present stage of development of spectroscopic conceptions in relation to chemical statics

Taken on the whole, the volume should find a place on the shelves of a certain type of worker there may be more such workers in the United States than in Great Britain One sympathises with the authors' objects in writing the book, but it tends to fall between two stools, in being a trifle too specialised for the able honours man in his last year, and yet too staid for the research worker who has any hopes of possessing or acquiring a *flair* He will go to the sources themselves, cost what it may

(2) Dr Kronig's "Band Spectra and Molecular Structure" consists of a series of lectures given at Trinity College, Cambridge, in 1929 Those who had the privilege of hearing them will recognise in the printed page the masterly grasp and rigour of the author He never for one moment permits himself to be deflected from the fundamentally theoretical nature of his subject, though a few kindly asterisks warn the weaker brethren when they may—with detriment it is true, but without abandoning salvation—omit paragraphs dealing, for the most part, with purely mathematical machinery In a word, it approaches the ideal book, and one wishes that there were more of it

The spectroscopist, in dealing with the molecule, has evolved a method whereby he is able to picture his assemblage as having three kinds of energy levels —(*a*) electronic, in which the nuclei are treated as fixed centres of force at a certain distance ρ apart, (*b*) vibrational, in which ρ is no longer a constant, so that the nuclei move to and fro along a straight line, and (*c*) rotational, in which the nuclei can take up any position in space The mathematical justification for classifying these energy levels by means of quantum numbers demands, as might be expected, the neglect of small terms in the Hamiltonian H, where H is a differential operator in the wave equation $(H - W)\psi = 0$

The application of perturbation theory leads to a knowledge of the influence of these rejected terms, that is, an understanding of the rotational distortion of spin multiplets and the so called Λ doubling in rotational levels The minor terms are also of importance for the phenomenon of pre dissociation

A chapter on the macroscopic properties of molecular gases is very welcome, in which Dr Kronig discusses the modern views on magnetic susceptibilities and specific heats Finally, some space is devoted to the newer theories of chemical combination, with special reference to homopolar molecules

If a couple of very minor criticisms may be made, it is only with the object of making the book quite indispensable One is that in a future edition the bibliography might be brought as up to-date as it is possible to bring it (the present one ends at November 1929, which is a somewhat remote date as physicists count time in these days for a work published in October 1930), and the other that an author's index should be provided, particularly to references in the body of the text One not infrequently knows the name of an investigator without being quite sure what precisely he investigated Dr Kronig's volume is the obvious place in which to look, and to find massive learning combined with great lucidity

F I G R

Qualitative and Quantitative Analysis

(1) *Analytical Chemistry* Based on the German Text of Prof F P Treadwell Translated and revised by Prof William T Hall Vol 1 *Qualitative Analysis* Seventh English edition, revised Pp ix + 610 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 23*s* net

(2) *Select Methods of Metallurgical Analysis* By Dr W A Naish and J. E Clennell Pp xii + 495 + 9 plates (London Chapman and Hall, Ltd, 1929) 30*s* net

(1) ALTHOUGH Treadwell's work is now a classic, there have been some changes and improvements in the present edition which seem to call for description There is, first, a concise but clear account of the fundamental physico-

chemical theories, with examples of their applications to analytical chemistry In the section on electrode potentials the American system of signs is adopted It is the opposite of that used in Europe, and although each system has advantages in particular aspects of the matter, it is desirable that a common system should be reached by agreement In the numerical tables there is, of course, the additional complication of the definition of the normal state

The solubility product relation, with useful numerical examples, is discussed in a critical manner on pp 21 3, and a comprehensive table of solubility products, together with the solubilities in pure water calculated from these values, is given The American editor points out that the values in the literature are not in good agreement, but it is evident that he has used a good deal of judgment in the selection of the values which appear in his table

On pp 461 2, however, reference is made to another table of solubility values given in a recent German edition of Fresenius's "Qualitative Analysis", with the remarks that "there is no mention of how the values were obtained", but that "the data given in the German text doubtless represent many hours of careful, accurate, and skilful analytical work" These values are, however, merely compiled from a part of Landolt-Bornstein's tables other than that used by the American author in the preparation of his table The differences are startling, for example, in the case of cupric sulphide, one value in Landolt-Bornstein is $3\cdot6 \times 10^{-4}$ gm /lit and another is $8\cdot7 \times 10^{-21}$ gm /lit Prof Hall considers that the lower values for the solubilities of sulphides better represent the behaviour of these substances in qualitative analysis

The preparation of reagents (in which the desirability of using solutions of known strength is emphasised) and the reactions of the more common metals and acids follow, and in the latter section (which occupies most of the book) it is satisfactory to find practically all the newer tests which seem likely to have a permanent value On p 88 there is some confusion, in the description of Ball's reagent, between nitrites and nitrates The division of the metals into groups follows the classical scheme, and there is no doubt that, with the average student, this gives very satisfactory results Alternative schemes of separation of the constituents of a group are also given, the notes on these separations being full and informative, and a most valuable feature of the book The acids are dealt with on the basis of a scheme due to Bunsen, depending on the properties of the silver and barium salts

Pages 497 567 deal with the reactions of some of the rarer metals, a subject which is becoming increasingly important in view of the extending use of these elements in industry The analyst who omits to test for elements like molybdenum, tungsten, titanium, and vanadium may overlook the most essential part of the material in his hands. The book closes with a scheme for the detection of all metallic constituents, adapted from the work of Noyes and Bray ("Qualitative Analysis for the Rare Elements", New York, 1927)

It will be seen that the new edition of Treadwell's "Qualitative Analysis" is one which, in the hands of teachers and of more advanced students, will be found of the greatest utility, and it provides a valuable work of reference For the elementary student it is, of course, too detailed, but it is suitable for students who have completed a course of intermediate standard The amount of information contained in the book is astonishingly large, and from this point of view the price, although somewhat high for the student, is reasonable

(2) In an introduction to Naish and Clennell's book, Sir Harold Carpenter points out that the work is one which will be useful to professional metallurgists, assayers, chemists, and students, principally because the methods it describes have been selected on account of their accuracy and their general suitability for the purpose in view Most of these methods have been actually tried out by the authors themselves, and this considerably enhances the value of the work, distinguishing it from so many of the often careless, expensive, and tedious compilations, with little exhibition of critical faculties on the part of the authors, which continually pour on the scientific book market, and particularly from Germany Another valuable feature of the present work is that equal prominence is given to both the rare and ordinary elements As Sir Harold Carpenter says, the majority of modern works on analysis ignore many of these elements, yet "if experimenters were to examine their specimens more frequently for the rare elements, they would probably be detected in many minerals and metallurgical products in which they are not suspected" It is within the reviewer's knowledge that vanadium in an industrial product has more than once been returned as 'copper' by chemists of considerable ability

It may be agreed, therefore, that the aims of the book are sound, and that the choice of topics is sufficiently wide to make it applicable to most metallurgical materials The only matter which calls for detailed comment is how the methods proposed by the authors are likely to work in the laboratory Chapters on mineral analysis, electrometric titrations, and spectrographic methods have been contributed by specialists, from which we may conclude that such methods are not yet in common use in the metallurgical laboratory, since otherwise they would have fallen within the experience of the main authors, who, nevertheless, consider them "to be of the greatest interest and value to metallurgical chemists" The reviewer has tested the remaining text by looking up a few problems in quantitative analysis in which he has been interested and which are not dealt with in the ordinary books In all cases, a method was described which had every appearance of reliability The details given in nearly all the descriptions reveal a familiarity with the actual methods on the part of the authors which inspires confidence

The book contains a large amount of material, well arranged and with useful cross references Qualitative analysis of the common metals and acid radicals and rare metals, preparation of solutions, sampling, selected methods for the quantitative analysis of the elements (arranged in alphabetical order with bibliographies), analysis of commercial metals, non ferrous alloys, iron and steel and ferro-alloys, ores, slags, metallurgical products (drosses, ashes, scrap, and so on), including assaying, refractory materials, and coal, are all dealt with in a very practical manner, and the chemist who follows the clear directions of the authors may hope to carry out the operations with success The book is well printed and provided with a good index It should commend itself to a large number of chemists

J R P

Chemistry of Sulphur and Selenium

A Comprehensive Treatise on Inorganic and Theoretical Chemistry By Dr J W Mellor Vol 10 *S, Se* Pp x + 958 (London, New York and Toronto Longmans, Green and Co, Ltd, 1930) 63*s* net

IT is more difficult to write an adequate review of the tenth volume of Mellor's "Comprehensive Treatise" than it was to review the earlier volumes, since the author's methods of presentation have long since become standardised and are now quite well known Indeed, an intelligent reader might hope to predict the general characteristics of the volume on sulphur and selenium by studying those on the related elements, in the same way that Mendeléeff predicted the properties of *eka-* and *dwi-*manganese from those of contiguous elements in his Periodic Classification From this point of view, the new volume is 'true to type' and presents no marked contrasts with those which have preceded it An inspection of the paragraphs dealing with subjects with which the reviewer is most familiar compels him, however, to pay a tribute of admiration to the almost uncanny way in which even the most obscure researches have been included in the author's survey

The volume on sulphur and selenium includes many interesting topics, perhaps because sulphur shows some tendency to mimic carbon by forming chains of atoms, leading to the formation of hydrides, chlorides, and oxy acids containing several atoms of sulphur Both sulphur and selenium also present interesting phenomena of allotropy Subjects such as these, as well as the vast range of data that have resulted from the intensive study of compounds such as sulphur dioxide and sulphuric acid, are adequately covered in the new volume On the other hand, it is difficult to discover any reference to the 'parachor', since references to molecular volume and surface tension are not followed by data for this derived function The retention of formulæ which represent sulphur and oxygen as being joined by a non polar double bond follows naturally from this point of view, but is definitely misleading in view of the evidence provided by Sugden and by Phillips that this link is semi polar—a rule to which no exception has yet been found The formulæ thus retained are historically correct, but create a 'pre War' atmosphere, which is not justified by the up-to-date character of the text

Dr Mellor is to be congratulated on the progress which he has made, since he has now covered nearly all the elements except those which occupy the eighth column of Mendeléeff's table These interesting and important elements will, however, probably call for two, if not three, additional volumes, before the task which the author has set himself can be finished Even at this late stage, it may perhaps be useful to suggest that the page headings might be employed to indicate the contents of the sections into which each chapter is divided, instead of repeating the name of the element at the head of each page—for example, more than 300 times in the case of sulphur

T M L.

Our Bookshelf.

Anthropology and Archæology

(1) *The Circle and the Cross a Study in Continuity* By A Hadrian Allcroft In 2 volumes Vol 2 *The Cross* Pp vii + 454 + 4 plates (London Macmillan and Co , Ltd , 1930) 12*s* 6*d* net

(2) *The English Parish Church* By A R Powys (The English Heritage Series) Pp xix + 165 (London, New York and Toronto Longmans, Green and Co , Ltd , 1930) 3*s* 6*d* net

(1) In the first volume of this work, which was published separately, the author made a study of the tradition of the pagan circle In the second, which appears after his death, he has turned to the cross, the early Christian church in Britain and Ireland, and traces its relation to the antecedent circle His thesis is that paganism and Christianity, both being cults of the dead, the converts to the new faith continued to worship at the old holy places, the mounds and burial places of the dead, which became the site of the Christian church, and to use them as the place of interment and of assembly for the discussion of the affairs of the community and for games, feasts, and fairs On a review of the evidence, the author makes out a strong case for carrying this continuity much further in detail than has been done before The identity of the places of worship of Christianity and paganism has been frequently argued , it is supported by the letter of instruction from the Pope to Mellitus permitting the use of pagan shrines for Christian worship, even if other evidence did not point in the same direction Mr Allcroft has greatly extended the field in which continuity of practice and belief must be allowed On certain points, however, he has pressed his theories rather far, as he himself would have been the first to admit His assumption of a widespread Celtic influence in the area of the Saxon church solves many of his problems, but it would be hard to prove

(2) In " The English Parish Church " Mr Powys has given an account of the church as an institution in the rural life of the past, for the benefit of overseas visitors and those of our own public whose interest has been aroused by the efforts now being made to preserve any relics of an earlier day Unlike Mr Allcroft, he holds to the manorial origin of the parish church, and makes the early Saxon church his starting-point His chapter on the secular uses of the church building may profitably be compared with the treatment of the same subject in Mr Allcroft's book

A Book of the Basques By Rodney Gallop Pp xii + 294 + 16 plates (London Macmillan and Co , Ltd , 1930) 15*s* net

Mr Gallop views the Basque with the eye of a realist He heartily condemns imaginative attempts, on insufficient acquaintance, to portray him as a romantic relic of a vanishing race Instead, he finds him a reserved, unimaginative individual, with a strong sense of humour and a pronounced bias towards independence, very markedly shown in his attitude towards his Spanish neighbours in past history While it is true that the Basque is vanishing, it is not the race but the culture that is disappearing A vigorous commercial and industrial activity carries with it development on lines that are purely Spanish It is remarkable that this energy shown by the Basques on the south side of the Pyrenees is not to be found among the French Basques

Mr Gallop does not profess to solve the philological and ethnological problems of the race For the benefit of his readers, he summarises the theories which have been put forward, just as he describes the country and some of the salient events in Basque history, in order to provide a background for and an insight into Basque character His main interest is the primitive culture of the people, and particularly their songs, plays, music, dances, legends and superstitious beliefs All these he describes in considerable detail and analyses with penetrative insight These chapters of Mr Gallop's book will repay detailed examination It is evident that the Basque has a great power of assimilation as well as of improvisation The result is that, while borrowing from outside sources (the origin of some of the folk-music is to be recognised at once as some popular air from another country), the element borrowed has been moulded to conform to a perfectly definite racial type On the other hand, the folk dances present many features of a very primitive character, which Mr Gallop, without doubt rightly, ascribes to a primitive spring ritual

The Bronze Age By Prof V Gordon Childe Pp xii + 258 (Cambridge At the University Press, 1930) 8*s* 6*d* net

Prof Childe's book on the Bronze Age is modest in appearance , but that is no criterion of its merit He has given his readers what might well be termed a complete handbook of the period, having in view the needs of the beginner and that useful person, the general reader He takes up the story of prehistory where it was left by Mr M C Burkitt in " Our Early Ancestors ", and begins with the discovery by early man that certain kinds of stone are susceptible to treatment by heat—the discovery of metal working From this germ he traces the development of Bronze Age culture, highly elaborated in technology and art and relatively advanced in its system of commercial and international communication

The general sketch of cultural conditions is followed by a section on the typology of the Bronze Age, in which the various classes of objects of material culture are passed in review and the development of each within the period is followed up Finally, the history of cultural groups and cultural movements is traced in so far as this may be deduced from the material provided by archæological discovery

It is scarcely necessary to say that Prof Childe's treatment of his subject matter is thorough and individual His unrivalled knowledge of the archæology of the Danubian area enables him to speak with authority on the obscure racial or, as he would prefer to put it, cultural group movements at the beginning of his period He has an interesting if not very conclusive chapter on the races of the Bronze Age, but his most interesting point is his conviction of the persistence of Bronze Age peoples through later periods It is more than probable that he is correct, but he is no less apt in pointing out that in Britain, at any rate, much research is necessary before a definite conclusion can be reached Especially is this true of the bearing of folklore on the question

Decorative Patterns of the Ancient World By Sir Flinders Petrie Pp 17 + 88 plates (London British School of Archæology in Egypt, Bernard Quaritch, Ltd, 1930)

THIS volume is intended to serve as the first outline of an index to "all the decorative imaginings of mankind", an undertaking indeed of no little magnitude Here, however, certain limitations are observed Much sufficiently known already is avoided, the time series limit is set at A D 1000, the examples are drawn only from Europe and western Asia (especially Egypt, Mesopotamia, and the Mediterranean), with their links in other lands Sir Flinders Petrie here touches again on the value of decorative design as presumptive evidence of connexion between the designers, where historic connexion between the designs can be traced, on the ground that purely decorative design has no stimulus of pressure towards use or invention such as that which underlies an essential obviously needed This principle is illustrated often when designs are brought together, as they are here, arranged under their classes Among them, perhaps the most striking example is that with which the series opens, a central figure with an attendant pair of lions, wolves, or other animals, one on either side This is one of the earliest motives of Egypt and Mesopotamia which persists through the ages down to the present day, when it appears as the lion and the unicorn of the Royal Arms and in the supporters of armorial coats

Biology

An Introduction to Vertebrate Embryology By Prof H L Wieman (McGraw-Hill Publications in the Zoölogical Sciences) Pp xi + 411 (New York McGraw Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1930) 20*s* net

THERE can be no doubt that the easiest approach to the study of vertebrate anatomy is the development of the embryo and its organogeny In recent years, in American colleges and universities, there has been a tendency to relegate certain of the initial subjects of the crowded medical curriculum to the two pre medical years of study, and to combine the teaching of embryology with comparative anatomy and histology Thus a wider and more generalised field can be covered than is permissible in human embryology alone In the book under review, considerable space has been devoted to questions of general development, cytology, and the early development of *Amphioxus* and the frog Reference is made to some of the more recent work of Spemann, Mangold, and Marx on 'organisms' or embryo-forming materials

As regards the remainder, the treatment of the development of the chick, pig, and man follows conventional lines and draws for its inspiration upon Lillie's "Development of the Chick" and the "Contributions to Embryology" of the Carnegie Institution of Washington Throughout, it has been the aim of the author to direct attention to the experimental aspects of the subject, and to make the descriptive material of the book complement the work in the laboratory, for which a manual has been prepared and published separately

The illustrations are not all that might be desired In the case of those of the development of the human venous system (Figs 161-163) the differentiation of the components is not made sufficiently clear to aid the student in understanding what is a rather complicated series of steps It is doubtful, too, whether the substitution of "sudoriparous" for "sudorific" as applied to the human sweat glands is an improvement in terminology

Histological and Illustrative Methods for Entomologists By Dr H Eltringham With a Chapter on Mounting Whole Insects, by H Britten Pp xi + 139 (Oxford Clarendon Press, London Oxford University Press, 1930) 7*s* 6*d* net

IN the space of 140 pages, Dr Eltringham has been successful in furnishing a concise yet lucid account of the standard methods employed in the study of the anatomy and histology of insects The initial chapters of the book are devoted to a description of the apparatus and materials required for the cutting and staining of sections There is a useful chapter on the dissection and preparation of the genitalia, the characters of which are now extensively used by systematists for the differentiation of species Of not the least importance is the chapter on the mounting of small entire insects, contributed by Mr H Britten, who recommends a method which is at once simple, effective, and time-saving

Every biologist recognises that good illustration is the handmaiden of morphology, and the entomologist with a bias towards anatomy will be encouraged to learn that there are several mechanical aids that can be used in preparing drawings of his subjects that render the lack of a natural artistic ability a matter of minor importance In teaching structural complexities of individual insect parts, models have a decided value, and the author has shown how simple models can be prepared at very little cost Useful hints on the colouring of lantern slides and photographs are also supplied for the benefit of those who are called upon to lecture on entomological topics.

Although it was the admitted intention of the author to cater for the needs of the amateur entomologist with no laboratory training, the book will also prove a useful guide to those who have adopted entomology as a profession A E C

Couleurs et pigments des êtres vivants Par Dr Jean Verne (Collection Armand Colin Section de biologie, No 123) Pp 219 (Paris Armand Colin, 1930) 10 50 francs

At every turn the students of natural history and of biology are compelled to consider the colorations of animals, and the first essential is to know what are the physical and chemical characters of the pigments with which they have to deal—and, if possible, how they are produced Some pigments are excretory, others for respiration, others for nutrition, and others to fix energy (chlorophyll) Living matter has a colour of its own and there are pigments in the blood and other internal tissues, in special pigment cells, usually provided with pseudopodia, and in the exoskeletons of animals Plants have chlorophyll and the colours in fruits are especially interesting Then there are colours due to reflection, to refraction, and to light decomposition Lastly, an animal may be coloured by its food The discussion from the point of view of protective coloration is very short, but it is unnecessary, since the facts relating to all types of colour are given succinctly so that the student may judge for himself We recommend this as a book useful to and within the means of every biologist It has an excellent bibliography

Chemistry

Recent Advances in Physical and Inorganic Chemistry By Prof Alfred W Stewart Sixth edition Pp xi + 387 + 5 plates (London, New York and Toronto Longmans, Green and Co, Ltd, 1930) 18*s* net

The new edition of Prof Stewart's "Recent Advances" provides striking evidence of the rapidity with which fundamental facts and theories of physical and inorganic chemistry have developed, since there is scarcely a single topic in the whole volume which could have been foreseen when the first edition of the book was issued Thus, the foreground of the picture is now occupied by line spectra and X-ray spectra, and the background by band spectra and Tesla-luminescence spectra, whilst the centre is devoted mainly to radioactivity, positive rays, and other aspects of the problem of atomic structure Amongst these chapters on atomic physics, there are interpolated a few of a more chemical character, dealing with newly discovered elements, with various forms of active hydrogen, and with some new hydrides This gives to the book the character of a very modern inorganic chemistry, but the inclusion of physical chemistry in the title is definitely misleading, since there is no reference of any kind to recent advances in this field (as it is commonly defined), with the exception of a belated chapter on "The Donnan Equilibrium", which might have appeared in an earlier edition of the book, but is now wedged uncomfortably between chapters on "The Periodic System" and "Some Flame Reactions"

Whilst, therefore, Prof Stewart has provided an up-to-date report on atomic physics and related topics, it would be a *reductio ad absurdum* to pretend that a book in which dipole moments and strong electrolytes are not mentioned can serve as a guide to the very real advances which have been made in physical chemistry since the War It should, however, be made clear that it is the title of the book that is at fault, and not the contents, since these are full of interest and contain many valuable references to work which is only beginning to find a place in the systematic text-books of inorganic chemistry

The Study of Crystals a General Introduction By T V Barker Pp xvi + 137 (London Thomas Murby and Co, 1930) 8*s* 6*d* net

It is greatly to be hoped that science teachers will respond generously to Dr Barker's efforts to mitigate the ill effects of specialisation in science The subdivision of natural science into several branches, while unavoidable in consequence of the extension of scientific knowledge, is unfortunate The teacher should endeavour to treat science as a unit so far as possible, that his pupils' knowledge may be built on the broadest possible foundations But when it comes to the study of crystalline matter, he is chary of handling a subject he has never been taught Dr Barker's book should assist him greatly, indicating how a study of crystals may readily be incorporated into the usual courses in chemistry and physics Moreover, benefit will be felt in the teaching of solubility and other phase-rule relations, heat and light, and the concept of isomorphism and polymorphism and the like

Of the value of such a course to the pupil, no one can doubt who has met the numerous examples in physical chemistry where the slightest experience in the study of crystals under the microscope would have avoided grave error To those workers who have not had the benefit of such experience or instruction, the book may be cordially recommended, it should help to dispel the illusion that crystallography is essentially and necessarily a matter of difficult trigonometry and of no practical value M H H

A Text-book of Organic Chemistry By Dr A F Holleman Seventh English edition, completely revised with the co-operation of the Author Pp xx + 594 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 17*s* 6*d* net

The great success of Prof Holleman's text-book, of which thirty-seven thousand copies have been issued in all and in nine languages, is certainly in part due to the point of view which the author expresses in the preface to the present edition "So long as there is a public to buy it," he says, "a novel can be reprinted unchanged, but even with an interval of only a few years between successive issues, each new edition of a text-book

of chemistry needs not only careful revision, but also the rewriting of some of its chapters" Prof Holleman has taken into account the recent advances in the subject, including the constitution of the dioses, enzymes, and particularly the applications of physical chemistry to organic chemistry—a feature which has always been noteworthy in previous editions More attention is given to fundamentals than in most text books, and in its present form the book is by far the best treatise for students which is available Its use will make the subject interesting and provide a stimulus for further study

The Structure of Silicates By Prof W L Bragg Pp 69 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 5 gold marks

It is unnecessary to insist on the significance of this monograph from the point of view of the crystallographer Under its somewhat uninviting title it does, however, also include much of interest to the chemist, the points of similarity and dissimilarity between the silicon oxygen complexes which are of such importance in the inorganic world and the carbon chains and rings of organic compounds appearing clearly Other matters of importance which are dealt with are the correct formulæ for silicates—the atomic components should be expressed on the basis of a constant number of oxygen atoms characteristic of the type of structure—and Pauling's ideas upon valence, with the not dissimilar rules for the build of structures which have been developed by W L Bragg and Goldschmidt One feels after reading this book that it was a hopeless task to attempt to unravel crystal structure without the help afforded by X rays, but that now full description of all crystals is likely to be accomplished in the not remote future

Engineering

Johnson's Materials of Construction Rewritten by Prof M O Withey and James Aston Edited by F E Turneaure Seventh edition Pp xxii + 859 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 30*s* net

The application of scientific discoveries to engineering practice generally only becomes possible when new technique and new materials have been developed which make possible the application During the last century great advances have been made in engineering, and the success achieved has in no small measure been dependent upon the finding of new materials, developments of accurate methods of testing the properties of materials under ordinary and high temperatures under static and repeated stresses, and how these properties are affected by heat treatments and manufacturing conditions Further, the materials that are used in the largest quantities in modern engineering are irons and steels, which are subject to rapid corrosion in many atmospheric conditions, and thus where possible such metals, as well as the timbers, have to be protected by suitable coverings

The volume before us, after a preliminary study of the mechanics of materials, describes the machines and apparatus required for the carrying out of the many types of tests used in modern engineering practice, and then proceeds to deal with various types of structural materials in detail Timbers, cements, concrete, building stones, structural clays, ferrous and non-ferrous alloys are discussed Constitutional diagrams are given of the copper zinc and copper tin alloys, and interesting chapters are devoted to the effect of heat treatments and the form on the properties of metals Clearly drawn diagrams illustrating these properties, and excellent photomicrographs showing the structure of metals produced by various treatments, are given Chapters are devoted to the preservation of timbers and the corrosion of metals

The book is excellently printed, the diagrams are clear, and the work should prove of great service to engineering students as well as to those in practice

Hydraulics for Engineers and Engineering Students By Prof F C Lea Fifth edition Pp xii + 775 (London Edward Arnold and Co, 1930) 21*s* net

In the course of twenty two years, since its first appearance, Prof Lea's work has passed through five editions, with intermediate reprints—a fact which eloquently speaks for the popularity and acceptability of the volume to students of the subject It has grown considerably in bulk since the present writer reviewed it in Nature in 1908, and now numbers nearly 800 pages Designed to cover the vast field of engineering practice comprised in the modern science of hydraulics, the expansion is scarcely to be wondered at, and, indeed, in turning over the leaves, one does not find that there is any inclusion of inappropriate material or pleonasm of treatment

Nearly a fifth of the volume is devoted to a consideration of turbine and water wheel problems, and another important section of 130 pages is absorbed in a consideration of the subject of centrifugal and reciprocating pumps While the subject as a whole is treated comprehensively and as analytically as one might reasonably expect in a volume which aims at serving the needs of students, it is possible, of course, to point to some matters in which there is room for inclusion of material The treatment of flow in pipes and channels is full, but there is no mention to be found of Dr Herbert Chatley's researches in connexion with the Whangpoo and Yangtse rivers, or more than a meagre reference to the striking conclusions in Barnes' "Hydraulic Flow Reviewed", which the present writer came across on a first perusal, but failed to trace afterwards by means of the index Indeed, the index is a little defective on several points

These, however, are minor details Taking it as a whole, Prof Lea's work is a substantial and serviceable contribution to the literature on hydraulics, and, as heretofore, will be found an extremely useful guide to the practitioner, as well

as to the student The book is admirably produced and the diagrams are clear and distinct

The Elementary Principles of Wireless Telegraphy and Telephony By R D Bangay Third edition revised by O F Brown Pp xii + 268 (London Iliffe and Sons Ltd 1930) 10*s* 6*d* net

To anyone desiring instruction in the principles underlying the working of modern radio apparatus this work can be recommended It is necessary to have a working knowledge of electricity and magnetism and the principles of wave motion This is given first and then we have chapters on aerials receivers masts thermionic valves and triodes their use as amplifiers being explained There is a good chapter on the frequency stabilisation of transmitters descriptions being given both of control by tuning forks and by quartz oscillators The design of a modern broadcast radio receiver is fairly fully described and also the use of a c and d c eliminators

Stress is laid on the danger of amateurs using home made all electric sets which are connected directly with the public electric supply mains There is always a risk that sooner or later one of the outers of the public supply mains may make contact with earth thus raising the potential of the middle main to 200 volts or more In this case there is a real risk from shock and the fire risk is also serious The Institution of Electrical Engineers publishes regulations showing how these risks can be obviated There is a chapter on radio direction finding which gives in little space a description of the Bellini Tosi and the Robinson systems The final chapter discusses the propagation of waves and the causes and effects of atmospherics The lower ionised region of the atmosphere produces little attenuation on very short waves and hence short waves which suffer multiple reflections between the ionised layer and the earth frequently travel better by day than by night No method of eliminating entirely the effects produced by atmospherics has yet been found

Alternating Current Electrical Engineering By W Tolmé Maccall Second edition Pp viii + 496 (London University Tutorial Press Ltd 1930) 15*s*

THIS book can be recommended to students reading for the B Sc examinations of the University of London It gives the necessary groundwork for the electrical technology required in the examination Very little knowledge of the calculus is required and the author s aim has been to make the theoretical part of the subject easily intelligible to the average student This naturally prevents him discussing many of the difficulties that arise He gives however a fair number of references to advanced books and papers We were pleased to notice that he has brought the nomenclature into line with the British Standard Glossary (published by the B E S A) The word capacitance instead of capacity (electrostatic) seems now to be generally adopted

The chapter on harmonic analysis is rather brief No clear distinction is drawn between the Fourier analysis and the Lagrange method of interpolation Perry s method is an example of the former and Runge s method of the latter We think the best and most accurate way of analysing a wave is to apply the modern formulæ for mechanical quadrature to the Fourier integrals It is pointed out that various authors following the interpolation method of Runge have given schedules to facilitate the calculations when the harmonics have to be calculated to the eleventh or beyond One authority quoted divides the half period into 26 ordinates and then gives a schedule for getting the first 25 harmonics inclusive It seems to us that this would be a waste of labour The values of the harmonics above the ninth obtained in this way would probably be inaccurate unless it so happened that no harmonics greater than the twenty fifth were present

Easy Lessons in Television By Robert W Hutchinson Pp vii + 175 (London University Tutorial Press Ltd 1930) 1*s* 9*d*

IT seems fairly certain that television will have a great future but like all inventions it is difficult to predict when it will become commercially successful Of the systems in use that invented by Baird seems to have made the greatest progress and this little book gives an excellent description of it in non technical language Perhaps too much stress is laid in the opening chapter on the atomic nature of electricity It is not very instructive to quote numbers beyond our comprehension A clear description is given of the photoelectric cell which enables a varying light scattered by the object to be televised into a varying current of electricity The varying currents can then be changed by a neon lamp to a fluctuating light which can be received on a screen for television neon is found to be the best gas to use as it responds instantaneously to changes in the current

The thermionic valve and the radio receiving set are described and the book finishes with a description of the televising of a silent film (called telecinematography) television in the theatre and telephotography The Siemens system is used by the Post Office for transmitting pictures to Germany and Denmark the Belin system is largely used in France and the Bell system in the United States

Modern Bridge Construction a Treatise setting forth the Elements of Bridge Design and illustrating Modern Methods of Construction By F Johnstone Taylor Pp xii + 235 (London Crosby Lockwood and Son 1930) 15*s* net

A SHORT treatise on any branch of engineering may serve as an introduction to the subject as a handy book of reference or as a guide to the latest practice The book under notice may well do all these In twelve chapters the author deals in turn with masonry bridges small steel bridges trussed girders girder bridge construction steel bridges constructional details steel arch bridges swing bridges lifting bridges erection methods,

ferro concrete bridges, and suspension bridges The aim of the book in the first place is to meet the needs of the average civil engineer, who requires some knowledge of bridge design, and of the examination candidate It covers the ground in a plain, straightforward manner The use of higher mathematics has been avoided so far as possible, the diagrams are clear, and there are numerous references to recent bridge construction as described in the *Engineer*, *Engineering*, and other journals

Geography

Cornwall a Survey of its Coast, Moors and Valleys, with Suggestions for the Preservation of Amenities Prepared by W Harding Thompson for the Cornwall Branch of the Council for the Preservation of Rural England With Notes on the Antiquities of Cornwall, by Charles Henderson Pp xix + 130 + 42 plates (London University of London Press, Ltd , 1930) 17*s* 6*d* net

ANOTHER handsome, well illustrated quarto has been added to the library dealing with the preservation of English landscape The suggestions of most general importance are those relating to the coast Support is given (so far as concerns Cornwall) to the proposals which have been made to the National Park Committee, that in Cornwall and the opposite peninsula of Pembrokeshire the National Coast Parks of Britain should be situate In the opinion of the authors of the Cornwall survey, " The formation of a National Coastal Park would afford lasting benefit to visitors from urban centres, and incidentally it would benefit a county suffering from acute industrial depression

The frontages for coastal parks, shown in a special map, are nearly the same as those suggested in my evidence to the National Park Committee and my book upon the subject , but the authors of the present survey have improved upon those suggestions in one important particular, namely, by extending farther inland the proposed coast park on the west of St Ives, so as to include the district of prehistoric monuments which here, as in the Pembrokeshire promontories add greatly to the romantic interest of the scene The recommendation also that steps should be taken " with a view to keeping open a public footpath all round the coasts of Cornwall " is welcome This is, indeed, a matter which should engage the immediate attention of local authorities in every maritime county

VAUGHAN CORNISH

Grundzüge der Physiogeographie Mit Benutzung von W M Davis *Physical Geography* und der deutschen Ausgaben , zum Gebrauch beim Studium und auf Exkursionen Neu bearbeitet von Prof Dr Gustav Braun Band 1 *Spezielle Physiogeographie* Pp xii + 178 8 gold marks Band 2 *Allgemeine vergleichende Physiogeographie* Dritte Auflage Pp xii + 256 10 gold marks (Leipzig und Berlin B G Teubner, 1930)

PROF BRAUN has based this small text book of physical geography on the well known volume of Prof W M Davis which first appeared in 1889 and afterwards was translated into German The work has undergone thorough revision, which entailed rewriting several of the sections, including those on weather and climate It covers the whole groundwork of the subject, including the distribution of vegetation Some of the original illustrations remain, but many are new or derived from various sources, and their excellence is one of the best features of the book Particular attention has been paid to reference to original sources and each section has copious reference to books and papers A glossary of English and German technical terms is a useful addition The book should prove of great value to students, and fully equals any work of the same standard now available in English

Death Valley the Facts By W A Chalfant Pp ix + 155 + 16 plates (Stanford University, Calif Stanford University Press , London Oxford University Press, 1930) 16*s* net

Grand Canyon Country By M R Tillotson and Frank J Taylor Pp viii + 108 + 15 plates (Stanford University, Calif Stanford University Press , London Oxford University Press, 1929) 9*s* net

THESE two small and beautifully produced volumes, although they bear no indication of belonging to any series, have considerable resemblance in their point of view and scope Neither deals with new material nor is in the nature of a personal narrative, but both give useful summaries of facts of history and physical conditions They are, in short, handbooks of scientific information The volume on the Death Valley is the fullest and contains useful chapters on plant and animal life, in addition to sections on physical geography and geology Each volume has some well chosen photographic illustrations and a 'cartograph' or pictorial map printed on the end papers That of the Grand Canyon country is so full of whimsical pictures scattered over the map that a popular use of the volume is suggested The Death Valley map has no flights in imagination

Geology

Geochemie in ausgewählten Kapiteln Von W J Vernadsky Autorisierte Übersetzung aus dem Russischen von Dr E Kordes Pp xii + 370 (Leipzig Akademische Verlagsgesellschaft m b H , 1930) 25 gold marks

CLARKE'S invaluable " Data of Geochemistry " is justly so highly esteemed, especially in English speaking countries, that there has been a natural tendency to regard it not only as an indispensable compilation of data but also as a standard exposition of geochemistry itself Only recently has this tendency been checked by growing acquaintance with the brilliant work of Fersman, Vernadsky, and Goldschmidt A most useful and illuminating little book was published in French by Vernadsky in 1924 under the title " La Géochimie " In 1927 a revised translation appeared in Russian, and now a third and greatly enlarged

edition has become available, this time in German After an historical introduction, the mode of occurrence of the chemical elements in the earth's crust is passed in review, with special reference to their concentrated or dispersed distribution in the successive earth shells, including that of the biosphere The succeeding chapters deal in great detail with the geochemistry of manganese with silicon and silicate minerals, including the parts played by compounds of aluminium and iron and the significance of the colloidal state, with the carbon cycle and the geochemical activities of living organisms, and finally with the distribution of the radioactive elements and their relation to lead and helium and the earth's thermal history The book concludes with an excellent annotated bibliography and indexes of authors and subjects

The author is to be congratulated on a work of fascinating interest, imbued throughout with the spirit of research, and touching everywhere on points of great importance to geology and chemistry that are generally passed over in more formal text books As three other languages have already had their turn, we may perhaps be allowed to express the hope that when the fourth edition is prepared it may be published in English Its welcome is already assured

American Mesozoic Mammalia By George Gaylord Simpson (*Memoirs of the Peabody Museum of Yale University*, Vol 3, Part 1) (Published on the Othniel Charles Marsh Publication Fund) Pp xv + 235 (32 plates) (New Haven Yale University Press, London Oxford University Press, 1929) 5 dollars

This work forms a companion volume to the same author's monograph on the European Mesozoic mammals which was published in 1928 as a catalogue by the Trustees of the British Museum In the present volume the author has rounded off his investigations by a description of the pre Tertiary mammals of the American continent While there are here no faunas at present known quite so early as the Rhætic and Middle Jurassic of the Old World, there are, on the other hand, at least a few places where Cretaceous mammal remains occur A knowledge of what happened in this period is so essential to our understanding of the evolution of placental and marsupial lines, and the localities and their yield of specimens so scarce that the dozen genera of marsupials and three of placentals here catalogued by Dr Simpson acquire considerable importance

A large part of the general description of the six Mesozoic orders of mammals has already been given in the British Museum Catalogue, where also questions as to their reptilian origin and their interrelationships are fully discussed To this every reader of the present memoir will have to refer The two works with their excellent plates and figures, and the sound and workmanlike treatment of the subject, form an admirable and useful treatise

Limestones their Origins, Distribution and Uses By Dr F J North Pp xxiii + 467 (London Thomas Murby and Co, New York D Van Nostrand Co, 1930) 16s net

Few people realise the importance of the part played by limestone in the economic life of the nation It enters into nearly every phase of human industry, and on its varied uses Dr North has written a most interesting and readable book No aspect of the subject appears to have escaped his attention, he deals with the origin of limestones and their distribution in the various geological formations in such a manner as to make the book an excellent introduction to the science of geology, and it may be recommended confidently to the general reader who desires to know something of the history of the earth The book is profusely illustrated, and to each chapter is appended a list of references which form a useful bibliography of the subject

As evidence of the care taken by the author, the book is remarkably free from errors One, however, may be pointed out On page 242 it is stated that the lower part of the Speeton Clay "is of Jurassic age (corresponding to Portland and Purbeck Beds)" A similar mistake is to be found on page 185 There are no marine representatives of the Portland and Purbeck rocks in Yorkshire the beds referred to by Dr North are now placed in the Lower Cretaceous

Mathematics

Theory of Functionals and of Integral and Integro-Differential Equations By Prof Vito Volterra Edited by Prof Luigi Fantappiè Authorised translation by Miss M Long Pp xiv + 226 (London, Glasgow and Bombay Blackie and Son, Ltd, 1930) 25s net

This translation of lectures, delivered in 1925 before the University of Madrid and since corrected and improved by the author, gives a concise survey of 'functionals', first studied by him in 1887 under the name of "functions depending on other functions", and later called "functions of lines" The first chapter gives definitions, properties of functionals, and operations performed on them The second chapter treats of problems of the functional calculus and in particular of integral equations Then follows a chapter on the extension of the concept 'analytic function' to functionals and, more particularly, extensions of the Riemann and Cauchy theories of conjugate functions in the xy plane to conjugate functions in space The fourth chapter treats of the composition and permutability of functions, and leads to an extension of the concept 'power series of a variable' to functionals The fifth chapter deals with integro-differential equations and functional derivative equations and their relations to the Hamilton-Jacobi theory, the new quantum electro-dynamics, and Green's functions The last chapter gives a summary of the applications of functionals to a variety of topics, in order to give some idea of the wide range of the subject matter of the lectures we

may mention the calculus of variations, oscillations of lakes and membranes, and hereditary problems in dynamics, elasticity, and electromagnetism

As the treatment is very concise, and detailed proofs are rare, the book is difficult to read, but full bibliographies appended to the various chapters, frequent references in the text, and an excellent translation will no doubt prove of great assistance to the reader No one interested in the topics dealt with can afford to ignore this work by one of the most prominent Italian mathematicians

Vectorial Mechanics By Prof Louis Brand Pp xvii + 544 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1930) 25s net

THE book before us is intended as " an introductory text book on mechanics for students of engineering and physics " It fulfils the first of these functions perfectly, in so far as it includes a great number of problems and worked examples chosen from topics of special interest to engineers Physicists, how ever, are not so well catered for, and unfortunately some of the fundamental principles are not given in a form sufficiently general for the purposes of modern physics Thus, Newton's Second Law is stated only for invariable masses, and the Third Law only for central forces, no provision being made for extensions to relativity problems and to electromagnetic systems

These are but slight blemishes on an otherwise excellent book which should prove of great use to engineering students Vector methods are used freely and are sufficiently explained in two chapters on vector algebra and vector calculus A chapter is devoted to three dimensional statics, and it includes an elegant method of reducing the general system of forces, first to two forces and then to a force and couple There is a long chapter on the kinematics of plane motion with applications to linkages and various gears, and another on the dynamics of rigid bodies with applications to the balancing of masses, to governors of various types, and to the gyroscope as used in engineering Although intended primarily for students in American universities, it will no doubt be of interest also to English students and teachers

Topology By Prof Solomon Lefschetz (American Mathematical Society Colloquium Publications, Vol 12) Pp ix + 410 (New York American Mathematical Society , Berlin Hirschwaldsche Buchhandlung , Cambridge Bowes and Bowes, 1930) 4 50 dollars

THE monograph under review illustrates in a striking way the great progress made in mathematics in recent years even in so specialised a branch as *Analysis Situs*, for the bibliography includes nearly three hundred references, almost all to papers published during the last decade The work is not a text-book, but, as it were, a digest of research work done in the subject since the publication of Veblen's " Analysis Situs " in 1922 Consequently, it makes great demands on the reader's knowledge, and is not suitable as an introduction to the subject , but it is of great importance to the expert in topology, and will prove to be a mine of information for all engaged in research in this field

The topics treated are the elementary combinatorial theory of complexes, the topological invariance of the homology characters, manifolds and their duality theorems, chains on a manifold, product complexes, transformation of manifolds and infinite complexes, with applications to analysis and algebraic geometry The book is well arranged and clearly written, as may be expected from one who, like the author, has distinguished himself by research in the subject, and appears likely to exert a beneficial influence on future research

Miscellany

George Eastman By Carl W Ackerman Pp xviii + 522 + 25 plates (London Constable and Co , Ltd , 1930) 24s net

GEORGE EASTMAN is a man of great faith, enormous energy, and indomitable perseverance He left school at fourteen years of age (1868) and worked in an assurance agency, and a year later he became practically interested in photography In 1877, after he had been working hard making emulsions and a coating machine, often all night, for he was still engaged as a clerk during the day, he determined to make plates commercially, and in 1879 he patented his coating machine, and in 1880 he was in business for himself In 1884 he got the notion of a transparent film, and was obsessed with its advantages , and in the same year, in conjunction with Mr Walker, he patented the roll holder These were the beginnings of the Eastman Kodak Company

The company has not always sailed in smooth waters—far from it, but when his partners were pessimistic, when some of his employees conspired against him, when the Government took action against him because of the vastness of his business, and when in early times the company was in debt, Mr Eastman was always optimistic He wrote "The manifest destiny of the Eastman Kodak Company is to be the largest manufacturer of photographic materials in the world, or else to go to pot ", and he took good care to realise the former alternative He also wrote " I am a believer in one man management and that a Board of Directors is valuable only as an advisory instrument to a good manager " He believed in full-page advertisements and many of them In the year 1896 he made his one hundred thousandth kodak, and at the factories at Rochester (N Y) and Harrow was making about one hundred miles a week of film and photographic paper Mr Eastman has been a great and generally anonymous helper of the needy all his life, increasing his gifts as he was able until they reached millions of dollars

The author has used the enormous mass of documents at his disposal with much skill in writing the fourteen chapters, or essays, of which the book consists, and has appended a very full and useful index

The Indexing of Books and Periodicals By Dr John W T Walsh Pp 118 (London Edward Arnold and Co, 1930) 6s net

It cannot yet be said that the good index is the general rule, whether for books or for periodical literature, and no reader of NATURE will regard a new book on the subject as superfluous Dr Walsh's book does not deal with main theorétical principles, and contains little that is new for actual practice, but the main features that make for good indexing cannot be repeated too often, and they are here, on the whole, set out with due emphasis

Dr Walsh is, however, not always clear in his directions For example, an alphabetical series such as "Cat, Domestic—Catfish—Catgut—Cat skins" is characterised as most undesirable on one page, but appears to be justified by the rule given on the next And why does Dr Walsh say that the most suitable form of index for 'abstract' journals is the classified form, with a reference to the Brussels decimal scheme? It is not easy to see why this type of journal should be placed for this purpose in a class by itself, and why the alphabetical arrangement should here be discarded It may be advisable for the abstracts themselves to be arranged in class order, for they are designed to be used at the moment of publication as a survey of the current literature of their subject But for the annual index, which is only as a rule a finding tool for some specific feature and ought not to take the place of a 'contents list' (as Dr Walsh rightly points out), the arrangement would be most inconvenient In any case the inclusion of the suggestion without elaboration will only confuse the class of reader for whom this book is designed

The author has evidently read widely on his subject, but seems to have been unduly influenced by works on general cataloguing and classification, which have to some extent obscured for him the real nature and function of the index For all that, the book is a practical manual which contains much that will help the inexperienced

God in Christian Thought and Experience By the Rev W R Matthews (Library of Constructive Theology) Pp xix + 283 (London Nisbet and Co, Ltd, 1930) 10s 6d net

"To a discerning eye", says Dr Matthews in his preface, "it must be clear that the main question which is being decided in the world to-day, is whether or not the majority of men shall continue to believe in God" One of the difficulties with which the would-be constructor of a tenable theistic theory is faced is the absence of any generally accepted philosophy All we can boast is "a generally accepted body of knowledge which stands for the modern world as solid and unquestionable as the logic and metaphysic of Aristotle stood for the later Middle Ages", that is to say, natural science Yet science does not seem able to provide us with any solution of ultimate problems Here it leaves us unsatisfied

There is scope, then, for someone who, starting from the commonly accepted results of natural science, will tell us as much as he can from that point of view, and indicate exactly what we must *not* hope to learn from him Dr Matthews does not claim to attack the problem from this end, he takes as his starting point "the Christian experience of God", and tries, in view of it, to formulate a theory of the divine nature which may be acceptable to the reason, and not contradictory to the knowledge, of modern men Thus his book will interest theologians more than men of science Yet scientific workers may well acclaim any work which will enlighten theologians, and this the present volume can scarcely fail to do

Philosophy and Psychology

(1) *The Psychology of Insanity* By Dr Bernard Hart (The Cambridge Manuals of Science and Literature) Fourth edition Pp xxxv + 176 (Cambridge At the University Press, 1930) 3s net

(2) *Psychopathology its Development and its Place in Medicine* By Dr Bernard Hart Second edition Pp vii + 178 (Cambridge At the University Press, 1929) 8s 6d net

(1) DR BERNARD HART's little book has been reprinted almost annually since 1918, and now we have a new edition, the fourth The book gives an extraordinarily good account of insanity and may well be read by any educated layman, particularly the social worker, with great benefit Hart explains mental mechanisms like projections, which are of such common occurrence in the everyday life of the normal 'man in the street' This edition has had an introduction specially written for it, in which Hart gives a brief historical account of the influence of Janet but more particularly of Freud He points out how Freud's views have been developed and extended, although the original ideas remain much the same We cannot help thinking that everyone ought to read this book, and that the mental hygiene of the community would benefit by it

(2) In "Psychopathology" Dr Bernard Hart presents us with his Goulstonian Lectures delivered in 1926, with the addition of three chapters one on the psychology of rumour, one on the methods of psychotherapy, and one on the conception of dissociation These last three papers had all been published already Dr Hart naturally devotes a large amount of his space to the views of Freud He also amply considers the views of Jung, but unfortunately appears to have little use for the theories of Adler These, we think, might have been given more space, as they appeal to quite a number of clinicians who do not accept Freud's all-embracing use of the word sex

Lectures on Ethics By Immanuel Kant Translated from the German by Louis Infield Pp xiv + 253 (London Methuen and Co, Ltd, 1930) 10s 6d net

It is much to be hoped that this little book will attain a wide circulation It has several points of special interest, besides being a short handbook of practical morals, easily and pointedly written and with clear anticipation of the great thinker's main construction of ethics, which followed shortly after-

wards, in 1781 The interesting literary point is that we have in this book, taken down very fully or written out immediately afterwards, Kant's own words in lecturing, and the result is very similar, from the literary point of view, to most of the works of Aristotle

The main note of Kant's moral system is struck in the earlier section, where he puts aside the Aristotelian doctrine of the mean as an obvious idea of no depth or scope, and lays down his own canon of the moral imperative

Two other points of special interest to contemporary thought stand out conspicuously One is the frequent reference to the claim of mankind as a whole "We should have but a low opinion of ourselves as individuals, but as representatives of mankind we ought to hold ourselves in high esteem" We are to do right not because it is the will of God, though we are led also to believe that it is that, but because it is the prerogative of our nature to do so, all mankind speaking to us through the individual conscience

The other salient point is the ideal agreement of mankind, which gives us in its purest form the sanction of the moral imperative, and should, in the practical and political form, be the object of all good men to achieve by law and institution on earth Kant's defence and advocacy of a League of Nations is nowhere more convincingly and fervently expressed than in the concluding paragraphs, which might well be adopted as a motto by the League of to-day F S M

The Human Mind By Karl A Menninger Pp xiv + 477 + xi (New York and London Alfred A Knopf, 1930) 21*s*

Dr Menninger, who is a well-known American psychiatrist, has attempted to place before the lay reader the problems of mental disorder This is a difficult task, for the subject is a highly technical one, and to make it intelligible and at the same time preserve its dignity would appear to be a task of the severest Yet the author has presented what is probably the best account of the human mind viewed from the abnormal side It is a book which may be read to great advantage by psychiatrists as well as the lay reader The author's explanation of mental mechanisms looked at from an analytic point of view is excellent, and his case records, which are perhaps the most fascinating part of the book, show an extraordinarily wide and sympathetic understanding of the distraught mind Some of the explanations of aberrant conduct may appear exaggerated to the uninitiated, but they are very familiar to those who have to deal with the mentally abnormal

Don Juan and other Psychological Studies By Prof Gonzalo R Lafora Translated by Janet H Perry Pp 288 (London Thornton Butterworth, Ltd , 1930) 7*s* 6*d* net

In "Don Juan and other Psychological Studies", Prof. Lafora, who occupies the chair in psychiatry of the University of Madrid, presents us with a series of most interesting studies of the abnormal He describes a patient of his own who very closely resembles the personality of Don Juan, and considers that it was quite possible for an individual so hopelessly erotic as Don Juan to have existed In his chapter on lay and religious miraculous cures, he points out that in Lourdes in 1923 only eighteen out of nearly a million invalids who attended were cured At the same time, no figures are provided of the many who die or are worn out by the journey A certain number of the cures relapse, yet we are told nothing of this In his study of cubism and expressionism he points out, as others have done, the resemblance between this form of art and the drawings of so many of the insane It is quite impossible to tell from a given picture whether the artist was sane or insane With this statement of the author's we are heartily in agreement The book throughout is a most level headed exposition of the abnormal, and to anyone familiar with the writings and drawings of the insane and mentally unbalanced it will appear by no means as an exaggeration

Sleep Why we need It, and How to get It By Dr Donald A Laird and Charles G Muller Pp x + 212 (London Williams and Norgate, Ltd , 1930) 6*s* net

Laird and Muller have made an excellent attempt to solve some of the problems of sleep in a practical manner It is typically American One is inclined to take the statement that 60° F is too cold for children to do good work *cum grano salis* The book, however, is full of practical points, such as small hints for diminishing noise, etc It is doubtful if in Great Britain many people lie and read in bed with a lamp attached to the book they are reading so as to assure a constant volume of light We cannot imagine moth balls helping to woo sleep Coffee is found to be not guilty of very many of the cases of disturbance of sleep laid at its door Excitement during the evening is a much more important sinner

Physics

A Treatise on Light By Dr R A Houstoun Sixth edition Pp xi + 494 (London, New York and Toronto Longmans, Green and Co , Ltd , 1930) 12*s* 6*d* net

This treatise, which is now in its sixth edition, is an admirably well balanced book It is divided into four parts The first treats of geometrical optics, a subject which some physicists forget is of great practical value The second discusses physical optics, finishing with the Kerr effect In part three, spectroscopy and photometry are discussed and the latest developments are described We expected the author to be more definite about colour blindness, on which he is an authority, but he has, perhaps wisely, confined himself to a brief statement of the main theories The descriptions given of the wonderful advances made in spectroscopy the spectral series, the infra-red, the ultra-violet, and the X-rays will be helpful to many The last section of the book gives the foundations of the mathematical theory and its later developments, due stress being laid on the quantum theories of the propagation of light and on Poynting's theory

of the pressure of light The chapter on ether and relativity is interesting The usual unconvincing statements are made about the relativity of time and space The author says, " Relativity is consequently now accepted as a faith It is inadvisable to devote attention to its paradoxical aspects ' The warning perhaps means that ' this way madness lies ', and many will agree with him It is pointed out that if we adopt Einstein's theory, since every observer has his own system of space and time, it is easier to abandon the conception of an ether and think of the light itself as having substance and moving through the void A description of the Hilger interferometer, Moseley's work on X ray spectra, cosmic radiation, and Kodacolor photography completes this useful volume

The Physics of Solids and Fluids with Recent Developments By P P Ewald, Th Pöschl, and L Prandtl Authorised translation by Dr J Dougall and W M Deans Pp xii + 372 + 4 plates (London, Glasgow and Bombay Blackie and Son, Ltd , 1930) 17s 6d net

ALTHOUGH of recent years the attention of physicists has been so much concentrated on electrons and quanta, the study of the properties of matter in the solid and liquid states has made great progress, with the result that text books on the subject have been growing old fashioned This volume contains a number of articles which appeared as part of the eleventh edition of Muller Pouillet's ' Lehrbuch der Physik ", and it is satisfactory to have them translated into English and collected in this convenient form Prof Poschl, of Karlsruhe, contributes an interesting chapter on elasticity and strength of materials, and a short chapter on the friction of solid bodies Prof Ewald writes a chapter on the mechanical structure of solids from the atomic point of view, in which the lattice theory of crystals is described and a useful account of single crystals is given Finally, Prof Prandtl, of Gottingen, contributes three chapters on the equilibrium and the flow of liquids and gases These are to be recommended to anyone taking up the scientific study of aerodynamics The illustrations are noteworthy, and special mention must be made of the fine photographs of slip and fracture by Dr G Sachs and those of stream lines in air and in water

Einführung in die Theorie der Wärme zum Gebrauch bei Vortragen, sowie zum Selbstunterricht Von Prof Dr Max Planck (*Einführung in die theoretische Physik*, von Prof Dr Max Planck, Band 5) Pp vii + 251 (Leipzig S Hirzel, 1930) 8 gold marks

THIS book is the last volume of a series entitled ' An Introduction to Theoretical Physics ", and it is in keeping with Planck's work that the last volume is on the theory of heat instead of the theory of electricity and magnetism Planck has shown that the theory of heat can be built upon the foundation of mechanics and electromagnetism

It is not intended that this volume should replace the two works on thermodynamics and heat radiation, so well known to all students of physics These branches of the study of heat are treated here in less detail, and an introduction to the theory of heat must have a more general character It is in four parts, and the content of the first, third, and fourth is familiar to students of Planck s contributions to the theory of heat These make very pleasant reading, especially the first part, for it is always a delight to read Planck on the laws of thermodynamics The second part is on the conduction of heat, and is the only part which tends to relieve the work of its rather specialised character It is an introduction to certain parts of the subject of heat rather than to the general theory

Les quanta Par Prof Georges Déjardin (Collection Armand Colin Section de physique, No 121) Pp 224 (Paris Armand Colin, 1930) 10 50 francs

PROF DEJARDIN'S ' modeste ouvrage " is actually an exceptionally good account of quantum theory in which he shows a nice appreciation of the extent to which mathematics can be tolerated by the ordinary honours student of physics The course followed is the historical one, the radiation problem being taken first, and, after that, specific heats, the photoelectric effect, the scattering of X rays, elementary spectroscopic theory, and, finally, the new quantum mechanics Details of experiments are not given, but there is no lack of illustrative results, generally from fairly recent publications There is a great deal to be said for the omission of such details even from more pretentious treatises, the student being left to refer to original papers for these—with of course precise directions as to what he is to read Prof Déjardin has succeeded in covering much ground in this small and inexpensive volume which if read in conjunction with P Bricout s Ondes et electrons , in the same series, furnishes a very satisfactory course on modern physics

Theoretical Mechanics the Theory of the Potential By Prof William Duncan MacMillan Pp xiii + 469 (New York McGraw Hill Book Co , Inc , London McGraw Hill Publishing Co , Ltd , 1930) 25s net

To the author's remark that the theory of the potential is very useful from the point of view of the physicist and very beautiful from the point of view of the mathematician, we may add that it introduces a class of functions of fundamental importance in connexion with wave mechanics Whether they are best approached for this purpose in the way given by Prof Macmillan is perhaps questionable, but there is no doubt that anyone who had worked through this volume would be quite familiar with many of their properties The ground covered is much the same as in several of the larger treatises on electricity, but the subject is here approached with a minimum of specific reference to the nature of the field A knowledge of the theory of integral equations is not assumed The one criticism offered is that rather much space has been devoted in the early chapters to the solution of distinctly elementary problems

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a Camera" Mr Maxwell visited the Birunga mountains in the spring of 1925 to study the habits and habitat of the eastern gorilla The series includes a photograph of a female gorilla startled by the photographer and making off in the foreground, carrying her young one on her back, and one showing the head and shoulders of an old male gorilla peering out from a dense curtain of tropical vegetation There is also a series of photographs of gorilla beds, or nests', one is constructed in the fork of a tree about 4 feet from the ground, but the older gorillas appear to prefer their beds on the ground itself, probably because they have little fear of leopards The Trustees have agreed to the purchase of a valuable collection of West African birds made by Mr G L Bates, principally in the highlands of the north eastern part of Sierra Leone and the adjacent French territory On the isolated peaks culminating in Mount Nimba were procured stonechats and pipits, the nearest relations of which are in the Cameroon highlands, hundreds of miles to the south Two specimens and photographs of the 'Coco de Mer' (*Lodoicea Sechellarum* Labill) have been presented to the Department of Botany by Miss Royston of Clophill, Bedfordshire The fruits are those of a palm which is restricted to the Seychelles, and were found floating in the Indian Ocean long before the tree itself was known The fruit is one of the largest known, the weight of one of those presented, though the specimen is hollow, is 30 lb A collection of some 2600 letters, many containing valuable mycological data, addressed to William Phillips, have been presented by Mr J Ramsbottom Phillips was a well known mycologist of the latter part of the last century, and wrote the Manual of the British Discomycetes"

Prof S Hanzlik has published a useful preliminary report on the unification of rainfall recording in *Bulletin* No 5 of Section d'Hydrologie, Union Géodésique et Géophysique Internationale, Venice, 1927 Numerous kinds of rain gauges are used in different countries, with reception areas ranging from 64 to 1000 square centimetres There is equally great variation in the height of the sides of the rain gauge and in other features Various practices obtain in the measure of snowfall Self registering rain gauges differ widely in principle The amount of rainfall in some countries is recorded on the day it falls in others on the day it is measured, which is the day following its fall Generally a "rainy day" is one on which at least 0 01 mm of rain fell, but in some countries 0 02 or even 0 5 mm is the minimum In some statistics the days with certain quantities of rain are distinguished, in others different quantities are chosen There are also various practices in the recording of frost and other phenomena The report is based on inquiries addressed to seventy eight meteorological institutes throughout the world It is not exhaustive, but yet is of much interest, and if it does nothing to suggest uniformity, it shows at least the wide diversity of methods employed in various countries Without some measure of uniformity, the comparison and discussion of meteorological data are made unnecessarily difficult

The Ordnance Survey has published a map of seventeenth century England and Wales as the second of the series of period maps of which Roman Britain was the first The basis of this map is a layer coloured, contoured sheet on a scale of one to a million The main roads are taken from Ogilby's survey of 1672 The principal ports and towns are shown by different symbols which indicate their importance Other symbols are used for castles, large houses, forts, and camp sites The chief events of the Civil War, with their dates, are indicated In many parts of the country the principal economic products are marked Forests are indicated by names but not symbols In spite of the large amount of information given, the map is clear and legible and gives no impression of crowding It is both a useful document and a fine specimen of cartographical skill A small plan of contemporary London is bound up with the map Prof G M Trevelyan contributes a short introduction on the general appearance of England in that century, and Dr J E Morris gives an outline of the campaigns of the Civil War There are also lists of events and prominent persons of the century Full details of the sources of the map are given The map alone is published on paper at two and sixpence, or mounted on linen with letterpress at six shillings The plan of London can be obtained separately at one shilling

The Reports on the health of the Navy and of the Army for the year 1929 have recently been issued (London H M Stationery Office Price 2s 6d and 3s net, respectively) In the Navy, the ratio of the incidence of disease was 482 03 per 1000 of the strength, being an increase of 36 04 over 1928 and of 14 91 in comparison with the five years' average There was some increase in venereal diseases, with 6361 cases, and in malaria, and a number of cases of influenza occurred On the other hand, there were only three cases of typhoid fever and two of paratyphoid fever, a remarkable record in a force of 86,240 men The total number of deaths was 254, of which 101 were due to injury In the Army, likewise, there has been some increase in the incidence of disease, the admission ratio having risen from 426 2 in 1928 to 468 5 in 1929 per 1000 of the strength This increase was, however, mainly due to an epidemic of influenza in the home commands, during the early months of the year Several diseases show a slight increase in the admission ratio compared with 1928, and the death and invaliding ratios also show slight increases Tonsilitis, which has been increasingly prevalent during recent years, again shows an increase. There were more cases of malaria in India, and one case of this disease arising in England is mentioned The patient had never been to a malarious country, and had been for more than ten years continuously in Great Britain The malaria parasite was found in his blood, so that there is no question of the diagnosis Venereal diseases show a satisfactory decrease

Fossil shells of ostrich eggs were found by the 1923 expedition of the American Museum of Natural History in the Central Gobi, and now A Tugarinov

(*Priroda*, 1930, No 7 8) reports the discovery of fragments of such shells in a number of localities around Troitzkosavsk, in Transbaikalia, which means a considerable northward extension of the area where ostriches occurred Most of the finds were made in an association with various objects of palæolithic culture, but in one case, fragments of shells were found away from any traces of human habitation The association of the shells with palæolithic camps and the fact that some fragments are perforated indicate that they were used as a material for making utensils As may be concluded from the size and the structure of the shells, they belonged to a species closely allied to *Struthio camelus*, the living North African ostrich, which differs strongly in these respects from the more southern species However, it does not appear possible to identify the Transbaikalian species with the North African one This discovery forms an interesting counterpart to the fact that the environs of Troitzkosavsk harbour fossil remains of an antelope of the genus *Spirocerus*, also allied to some recent African genera

RECENTLY we referred in these notes to the many problems of bird life in Britain which still await solution Yet birds are the creatures most observed by the amateur naturalist It need scarcely be said, therefore, that our knowledge of the habits, life histories, and reactions of mammals has many blanks, in spite of the fact that few branches of inquiry are of greater interest to the naturalist or of more practical importance to the agriculturist Moreover, it is just along the lines of observation most open to the field naturalist, such as the relationships of animals to their environment or the fluctuations of their numbers seasonally and annually, that further information is needed An excellent guide for the worker who desires to make useful contributions to such knowledge is Walter P Taylor's "Outlines for Studies of Mammalian Life Histories", a 12 page pamphlet recently issued in revised form by the U S Department of Agriculture (*Miscell Pub*, No 86, 1930) In the comprehensive scheme of studies outlined there, the author indicates the observations which ought to be made in elucidating the environment and its influence, the life history, structure and behaviour, and the relationship between the lower mammals and man The suggestions should stimulate systematised observations in the field

WE have received a letter from Col L A Waddell in which he takes exception to our notice of his book, "Egyptian Civilization its Sumerian Origin", in NATURE of Jan 24 He states that the fact is overlooked that it gives the fully attested inscriptional evidence for the complete identity of the pre-dynastic and dynastic Pharaohs with Sumerian emperors and their dynasties in Mesopotamia, based on the exact agreement which has been worked out for their names, achievements and order of succession He adds that so far from his chronology "hanging in the air", he has provided a solid foundation of fact for the first time for a chronology of Egypt, whereas those who follow what our notice termed the "orthodox" system differ among themselves by some thousands of years in the dates of the early dynasties While we have pleasure in placing Col Waddell's protest on record, it is evident that it restates, in brief, the argument of his book, which is dependent upon identifications which, it was made clear, we were not prepared to accept

GREAT progress has been made in the United States of America in the formation of children's museums In discussing "Children's Museums in our National Life", at Yale University on Nov 19, Miss Anna B Gallup pointed out that such institutions are now flourishing in Detroit, Indianapolis, Boston, Hartford, and Los Angeles, besides the children's museums maintained by Harvard and Yale Universities In addition to these seven, all established after the organisation of the original example at Brooklyn, others are on the way In Kansas City a small museum for children is soon to be opened, another is being planned as part of the California Academy of Sciences, and in Pasadena the movement has taken hold Even in Honolulu a building has been under consideration for the use of children, and a representative has studied the methods of the Brooklyn Children's Museum in order that the most may be made of the educational possibilities of the venture

THE *Bulletin* of the Michigan College of Mining and Technology for the year 1930–1931, which has recently been issued, contains full schedules of the subjects taught at this seat of learning Judging by the scope of the work detailed for chemistry, engineering, mining, metallurgy, etc, and from the illustrations scattered through the book, a very thorough education is made possible by the possession of first class equipment housed in ideal buildings and handled by a very competent staff That is where these schools of advanced instruction in the United States score over so many British centres of learning of similar standing, lack of adequate equipment or accommodation is bemoaned in almost every university in Great Britain in some faculty or other, but it is seldom that the same cry is heard from the other side To those interested in schemes of work and curricula, in questions of relative number of hours per subject in a group chosen for a degree course, it is instructive to turn to publications which tell us how other people do things, how qualifications are secured While headings and schedules can give little idea of the quality of the teaching or of the standard really achieved short of or compatible with the aims professed, much can be learned from perusal of a pamphlet of this kind, and correct assessment of international educational values is only one of the advantages ensuing therefrom

A GREAT deal of interesting matter on the methods and practice of boundary determination and demarcation is contained in *Bulletin* 817 of the United States Geological Survey, entitled "Boundaries Areas, Geographic Centers and Altitudes of the United States and the Several States" The history and the methods of marking the boundaries are given for all the States and for the international frontiers In several cases a lack of understanding of physical geo

graphy led to boundary disputes and readjustments, as in the case of the shifting bed of the Rio Grande between Texas and Mexico, or the Alaskan boundary dispute of 1898 The pamphlet contains also a great deal of statistical matter and several maps Of the latter, the most interesting is a large reproduction of the Mitchell map of British and French dominions in North America in 1755, on a scale of about fifty miles to an inch

PROF R F GRIGGS, of George Washington University, has recently returned from a botanical expedition to the Katmai volcanic region of Alaska (*Daily Science News Bulletin*, Science Service, Washington, D C) About twenty years ago, Katmai practically exploded and devastated a great area of country, which was left covered with volcanic ash This covering was almost devoid of nitrogen, and Prof Griggs has paid special attention to the plants which first populated this bare and arid soil The first plants were liverworts, and although there is little or no nitrogen in the soil, it is, of course, present in the plants themselves It is not clear at present whether the liverworts have the capacity to take nitrogen from the air themselves, or whether this power is associated with some fungus growing in close association with them Such close mycorrhiza like union of a fungus with a liverwort has been described on several occasions Prof Griggs proposes to study the question further on this group of plants, in the laboratory

DR WILLEM DE SITTER, director of the Observatory at Leyden, has been awarded the Catherine Wolfe Bruce gold medal for 1931 of the Astronomical Society of the Pacific "for distinguished services to Astronomy "

THE special exhibition at the Imperial Institute South Kensington, of the mineral resources of the Empire, which was noted in NATURE, Feb 14, p 248, will remain open until April 30 In connexion with this exhibition, Sir Edwin Pascoe, director of the Geological Survey of India, will give an address on The Mineral Wealth of India ", on Mar 12, at 5 30 P M Tickets for seats may be obtained from the Secretary, Imperial Institute, South Kensington, S W 7

THE fifth general meeting of the 'Dechema' (Deutsche Gesellschaft fur chemisches Apparatewesen) will be held, with that of the Verein deutscher Chemiker, in Vienna, on May 28 and 29 The subject chosen for the symposium is "The Separation of Solid and Liquid Substances" Offers of contributions should be sent in not later than Mar 15, to the head office of the 'Dechema', Seelze b Hannover

DR E R WEIDLEIN, director of the Mellon Institute of Industrial Research, Pittsburgh, Pa, has announced the appointment of Dr L H Cretcher to an assistant directorship in the Institute Dr Cretcher, who, since 1926, has been serving as head of the Institute's Department of Research in Pure Chemistry, will be in charge of a group of industrial fellowships concerned with problems in organo chemical technology Dr Cretcher was formerly a member of the organo-chemical division of the Rockefeller Institute, and in 1919 took up a research post in the laboratory of the National Aniline and Chemical Company He is best known for his work on sugar chemistry He has also contributed to the knowledge of pyrimidine aldehydes, oxidation of tertiary hydrocarbons, glycol ethers and esters, organic boron compounds, barbituric acids, chloro ethers, and equilibria in binary liquids systems

WE have received from the Association of British Chemical Manufacturers 166 Piccadilly, London, W 1, a well bound volume of 405 pages entitled "British Chemicals and their Manufacturers", which is printed in English and five other languages, French, Spanish, Italian, Portuguese, and German All the entries are classified under products in separate indexes in these languages There is also a section dealing with products under proprietary and trade names, the nature of the product being stated in the languages mentioned The volume may be obtained gratis by genuine users of chemicals on application to the Association at the address given above

A CATALOGUE (No 15) of upwards of 300 second hand works on botany, horticulture, zoology, and geology has just been issued by Mr J H Knowles, 92 Solon Road, S W 2

THREE short lists (B 7, B 8, and B 9) of second hand books on, respectively, botany, gardening and agriculture, natural history, and angling, fish and fishing have just reached us from Messrs Francis Edwards, Ltd, 83 High Street, Marylebone, W 8

APPLICATIONS are invited for the following appointments, on or before the dates mentioned -A junior research assistant in the department of chemical technology of the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington S W 7 (Mar 12) A sub inspector of quarries in the North Midland Division of the Mines Inspectorate of the Mines Department—The Under Secretary for Mines, Establishment Branch, Mines Department Dean Stanley Street, S W 1 (Mar 16) A chemical assistant to the advisory chemist of the School of Agriculture, Cambridge - The Secretary, School of Agriculture, Cambridge (Mar 19) Lecturers in, respectively, geography and mathematics and physical training and hygiene, at St Hild's Training College, Durham—The Principal, St Hild's Training College, Durham (Mar 20) A full time lecturer in civil and mechanical engineering at the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W 1 (Mar 20) An assistant secretary under the Middlesex Education Committee, having special knowledge of technical education and with experience in courses leading to national certificates in electrical and mechanical engineering and in building construction—The Secretary, Education Offices (H), 10 Great George Street, S W 1 (Mar 21) A professor of economics in the Panjab University—The Secretary, Universities Bureau, 88A Gower Street, W C 1 (Mar 28) A director of the Research Institute of the Rubber Research Scheme of Ceylon—

The Chairman of the Board of Management, Rubber Research Scheme, Peradeniya, Ceylon (Mar 30) A deputy director of the Public Health Laboratories, Cairo—The Under-Secretary of State, Department of Public Health, Cairo (April 14) A demonstrator in physics at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N W 1 (April 20) A lecturer and adviser in veterinary science in the Harper Adams Agricultural College and National Institute of Poultry Husbandry—The Principal, H A A C, Newport, Shropshire

ERRATUM —NATURE, Feb 21, p 268, five lines from end of notice of "The Economics of Forestry" by W E Hiley for "British Isles" read "British Empire"

Our Astronomical Column

Mapping the Larger Magellanic Cloud —A recent *Daily Science News Bulletin* issued by Science Service, Washington, D C, gives a summary of a paper by Prof H Shapley read before the American Association for the Advancement of Science at the recent Cleveland meeting, he stated that a detailed map of the larger cloud is being prepared, the cloud contains 200,000 giant and supergiant stars, each more than 150 times as bright as the sun, and more than 2000 stars that are each more than 10,000 times as bright as the sun

Another *Bulletin* gives a new estimate of the distance of the sun from the centre of the galaxy Dr Harlow Shapley had found a distance of 15,400 parsecs by taking the mean of two different methods, but, since that was made, Dr R J Trumpler has found evidence of appreciable absorption of light in the galactic plane, Dr van de Kamp has applied the necessary correction to Dr Shapley's figures, and finds that the distance is reduced to some 12,000 parsecs, or even less

The Eighth Satellite of Jupiter —This tiny body the magnitude of which is 17½, has been unobserved since June 1923 It was discovered by Mr Melotte at Greenwich in 1908, and was followed there for many years, but of late years the Thomson Equatorial, which is the only instrument there that is suitable for observing it, has been in use for stellar parallax and other researches There was danger of its being lost, as the solar perturbations are very large and the computation of them long and tedious However, Prof Numerov, of Leningrad, computed them a few months ago, and issued an ephemeris, Prof G van Biesbroeck has succeeded in photographing the satellite, and publishes eight positions, obtained from photographs on four nights, in *U A I Circ* No 310 The first position is

	R A (1930 0)	N Decl
Dec 16 20562 U T	$7^h\ 25^m\ 36\ 46^s$	$22°\ 54'\ 50\ 3''$

The observed places are about 8 sec smaller in R A than the predicted ones, and 10′ north of them These residuals are satisfactorily small after an interval of nearly eight years The plates were taken with the 24 inch reflector at Yerkes, with an exposure of 30 minutes

Variable Stars in the Globular Cluster Messier 3 (Canes Venatici) —*Astr Nach*, No 5747, contains a study of the light variations of 47 stars in this cluster, by Mr Paul Slavenas The plates used were 97 in number, and were taken by Dr J Schilt in 1926 with the 60 inch reflector at Mt Wilson The data for 30 stars were sufficient to deduce accurate periods these are given to the eighth decimal of a day, the shortest is about 0 288 day, the longest 0 708 day The majority lie close to half a day It will be remembered that it was from a study of the magnitudes and periods of Cepheids that the distances of globular clusters, the Magellanic Clouds, and the spiral nebulæ have been determined

Reference Stars for the 'Selected Areas' —The scheme, initiated by the late Prof Kapteyn, of intensive observations of stars, both bright and faint in certain areas distributed uniformly over the entire heavens, needs very careful meridian observations of the brighter stars in each area, since these have to serve as reference points for the plate constants, and the proper motions of the faint stars will depend upon them The Observatory of Leyden has just produced a catalogue of 1172 of these stars in vol 15, part 3, of its *Annals* They include all the 'areas' in the northern hemisphere except the polar one The catalogue bears the names of C H Hins and J J Raimond, jr, with Prof de Sitter as director The observations were made between 1921 and 1929 In 1922 a hand driven moving wire micrometer was inserted As there is no movable declination thread, the declinations were observed at different times from the Right Ascensions, the eye-end of the telescope being turned through a right angle Most of the stars have been observed at least twice in R A and three times in Declination The positions are reduced to the equinox of 1925 0

Occultation of Antares —Kwasan Observatory *Bulletin* No 189 contains an observation of the occultation of Antares on Jan 15 by Prof K Nakamura with the 30 cm Cooke refractor It was cloudy for the disappearance At the reappearance, the greenish companion emerged first, and the bright star some 4 seconds later It was seen first as a dim red glare, and took fully a tenth of a second to reach full brightness This is in good accord with the large diameter of the star, about 0 04″, found by the Mount Wilson interferometer The times of emersion in U T are

1931 Jan $14^d\ 20^h\ 2^m\ 27^s$ companion
30 9 Antares

The first time is noted as probably late

It is of interest to note that the first observation of the companion was made on the occasion of an occultation The *Berliner Jahrbuch* of 1822 records that Burg at Vienna observed the small star reappear five or six seconds before the bright one on April 13, 1819 He concluded that Antares is double Bode, however, discredited this, and added the note, "Antares ist kein Doppelstern" The companion was not seen again until 1844 (by Grant in India) and 1845 (by Mitchel in America) Incidentally the green colour of the companion is shown to be inherent, not a contrast effect, when it reappears before the bright star

The Cracow Astronomical Handbook for 1931 —This handbook, as usual, is almost entirely taken up with ephemerides of variable stars There are 391 eclipsing variables for which the dates of minimum are given, and 382 others for which certain elements are given There are also elements of occultations of stars by the moon for several stations in Poland There are also useful tables of precession, obliquity of ecliptic, etc The explanations are given both in Polish and in flexible Latin, which is very easy to read.

Research Items

Food Supply of India—In the presidential address delivered to the agricultural section at the seventeenth meeting of the Indian Science Congress at Allahabad (Calcutta · Asiatic Society of Bengal), G Clarke discussed the necessity of increasing the food supply to meet the needs of the growing population in India From a consideration of the agricultural returns for 1922–23 and 1925–26, it is evident that the area available for food production in India is 1 2 acres per unit population, whereas in America and France, countries comparable with India as regards the importance of agriculture, the corresponding figures are 2 6 and 2 3 respectively The amount of new land in India suitable for cultivation is no longer sufficient to provide the increased area required, so that the solution of the problem lies in increasing the yield of the land already in use Weather conditions and the shortness of the growing season are the chief difficulties confronting the agriculturist, but the use of modern methods of research, and in particular a closer study of the critical periods of crops, that is, those intervals during which the plant shows maximum sensibility to external factors such as moisture or nitrogen supplies, should do much towards the attainment of better results Further, green manuring is particularly advocated as an economical means for soil improvement and the maintenance of an adequate nitrogen supply From a comparison of conditions in other countries and analogy with the progress of the sugar cane industry in India, it is possible to obtain a rough estimate of the increased production likely to follow the application of scientific methods to agriculture After making due allowance for the inevitable lag in the adoption of improvements, and taking into consideration the abundant labour resources and responsive nature of the soil in India, it is thought that within the next two or three decades an increased output of 30 per cent in normal seasons may reasonably be expected Increased expenditure on scientific research is, however, assumed

Bionomics and Morphology of *Paraphædon tumidulus*– The intensive study of an organism is useful in entomology By making facts of structure known, it places in the hands of the morphologist material with which he can arrive at ideas of truer relationships It also serves as a means of giving clues of weak points in the insect's anatomy which may be used by the economic entomologist to bring it under control, if it is injurious in any way Dr Nellie F Paterson's recently published paper entitled "The Bionomics and Morphology of the early stages of *Paraphædon tumidulus* Germ" (*Proc Zool Soc*, Oct 22, 1930, pp 627-676) is an effort of this nature The insect belongs to the Chrysomelidæ—a large family of beetles which are all phytophagous, and consequently many of them are serious pests of cultivated plants The study was made in the zoological laboratory of the University of Cambridge while the author was holding a scholarship awarded by the University of the Witwatersrand, Johannesburg The study contains notes on geographical distribution, food plants and nature of damage, and details of life-history The exoskeleton and the internal anatomy are reviewed in great detail The paper is illustrated by four plates and seventeen text-figures An interesting feature is that the author has formulated a system of enumeration and nomenclature of the larval chætotaxy Although it may apply to some Chrysomelid larvæ, it cannot be a comprehensive scheme which would embrace the whole family Dr Paterson is to be congratulated on her fine study

An Australian Myriothela—E A Briggs (*Rec Austr Mus*, Sydney, **18**, 1930) gives an account of the salient features in the histology of *Myriothela harrisoni* from the coast of New South Wales The ectoderm of the hydranth is described as stratified, the supporting lamella is thin and from its outer surface extend simple or branched secondary lamellæ, on each side of which the well developed longitudinal muscle fibrils of the ectoderm are situated The endoderm presents the usual types of cells—goblet, gland, vacuolate, and storage The tentacles of the hydranth are remarkable for the extraordinary development of the supporting lamella in the capitulum where it is produced into radially arranged fibres which form the main mass in the apex of the tentacle The fibres keep this part of the tentacle expanded when the remainder is contracted The blastostyles, which are borne on the middle zone of the hydranth in such numbers as to hide the surface, are mouthless, and each is continued into a single terminal tentacle The mature gonophores borne on any one individual are of the same sex, both male and female gonophores have an apical opening representing the velar aperture

Biological Control of the Prickly Pear—Several species of *Opuntia* have spread very widely in Australia since their accidental introduction, and two species, *O inermis* and *O stricta*, have become very serious pests In 1912, the Queensland Government appointed a commission to investigate the natural enemies of these plants, and since 1919 the Commonwealth Government has co operated with Queensland and New South Wales, the work of searching for natural enemies of the prickly pear in its natural haunts being placed under the control of the Commonwealth Prickly Pear Board The whole of the cactus belt in the United States was examined, and some seventy different kinds of insects were found on the prickly pear Under the title, "Ten Years' Research on the Prickly Pear", C Schindler, of the University of Brisbane, gives an account of this work in *Discovery* for February Very striking success appears to have accompanied the introduction of the moth, *Cactoblastis cactorum*, which was found in La Plata in 1914, and re discovered in the Argentine and Uruguay in 1925 A shipment of eggs reached Australia safely in 1925 and was an immediate success The caterpillar tunnels in the fleshy stem and, living gregariously inside this spine covered fleshy mass, is protected against birds Schindler estimates that the area covered by the prickly pear in Australia is now being reduced by one million acres a year, as a result of the various methods of biological control now in use, instead of this pest spreading to about the same acreage of new country each year, as was formerly the case This Australian work will have considerable interest for other countries, for example, South Africa

Spiral Ringing and Solute Movement in Trees—Profs L H McDaniels and O F Curtis have published the results of their latest experiments on the ringing of trees in *Memoir* 133 of Cornell University Agricultural Experiment Station (October, 1930, 31 pages) The results refer mainly to the spiral ringing of apple trees, and the findings confirm the opinion of these workers that the phloem is the tissue most concerned in translocation, handling solutes taken in by the roots and foodstuffs elaborated in the leaves Photographs showing the effect of spiral ringing in increasing the fruitfulness of apple branches are given,

and the practice of tapping trees for oleoresin is also reviewed Lateral transference of solutes and foodstuffs in the trunk is shown to be slow, immediately after the ring has been made It is suggested that the meeting of the downwardly moving foodstuffs and the upwardly directed solute current causes an electrical polarity of the cells at the junction, that is, the incipient cambium, and the responses of plants to such practices as propagation, pruning, and grafting are discussed from this point of view The regeneration of the tissues following ringing has been studied, and leads to the conclusion that translocation rapidly becomes normal after the wounding

Selection of Maize for Germination and other Tests —Mr R C Malhotra, of St Mary's College, Kansas, writes to say that in germination tests of maize seedlings he finds that the irregularly shaped seeds taken from the tip and butt ends of the ear, especially those in which the embryo is located at the side of the seed, seldom if ever germinate The use of such seeds, even if of heavy weight, may cause an experimental error of 20 25 per cent in germination In the middle of some ears a number of compressed, thin, undeveloped, and starved seeds may be found They germinate promptly, probably because of the thin pericarp, but produce poor, under nourished seedlings and should be excluded from germination experiments In experiments with X rays and ultraviolet light, the effect of exposure is very different according to which side of the seed is exposed, as the embryo is much nearer one side than the other The embryo side should be exposed for uniform results

The Theory of Isostasy — In a critical review of isostasy by Hubbert and Melton, appearing in the *Jour Geol*, pp 673–695, 1930, the underlying theory is very clearly summarised, and special attention is directed to Hopfner's recent inquiry into the problems involved Hopfner claims that the observed gravity anomalies can be accounted for, without recourse to the principle of isostasy, by taking into consideration the effect of elevation and depression of the geoid relative to the spheroid of reference (Brun's term) These effects lead to the conclusion that gravity ought to be deficient over the continents and excessive over the oceans, as indeed it is, this being the leading fact that isostasy has been invoked to explain The authors state that although the results of Hopfner are admittedly qualitative, "they are of sufficient importance to cast a large shadow of doubt over the whole of isostatic theory" Against this depressing conclusion there appears simultaneously an important paper by Heiskanen in the *Am Jour Sci*, Jan 1931, pp. 39-50 It is admitted that the reduced gravity values g_0 are referred to the geoid, whereas the theoretical values γ are referred to the spheroid, but several lines of evidence are presented to demonstrate that gravity anomalies could be explained by Brun's term only if its quantitative value were about ten times greater than it actually appears to be Heiskanen concludes that Hopfner's arguments are founded on a qualitatively correct basis, but that he has greatly exaggerated the influence of the effects deduced Readers of the first paper referred to above should on no account omit to study the second Taken together, they provide a most illuminating account of an intricate subject that is rarely clearly understood

Gas in Relation to Oil Production —B J Ellis discussed this subject at the meeting of the Institution of Petroleum Technologists last December, and, in effect, gave a very practical interpretation of S C Herold's well-known recent work on simple perfect fluids and their mechanics As he (Mr Ellis) pointed out, Herold's thesis deals in the main with ideals—perfect gases and liquids in homogeneous reservoirs, and although the principles enunciated have obvious application to oilfield circumstances, such conditions cannot be realised in actual practice The author proceeded to examine the concrete variables, the gas, oil, and the reservoir, as existing in Nature, and thereafter sought to modify Herold's theories in terms of actual conditions Such a study is bound to bring in its train the more practical questions of repressuring oil pools and gas drive, and some attention was devoted to these aspects of field development, while a possible method of increasing the recovery of petroleum by a modified form of gas drive was indicated In this latter conception is probably the most interesting part of the paper What is known as 'centripetal production' was shown to be one of the best means of obtaining more oil from a reservoir from which utmost production had been obtained by normal methods, a means apparently applicable, at least in theory, to virgin production Briefly, centripetal production implies the injection of gas by wells specially drilled for the purpose at geometrical points determined by the positions of output wells and their circles of influence, injection should take place at a pressure equal to or slightly higher than the original reservoir pressure

River Flow Records in the Ness Basin, Inverness shire —Previous notice has been given in NATURE (Mar 1 and 29, 1930, pp 334, 514) at some length of the series of observations of river flow in the Ness Basin, Inverness shire, made in 1929 by the voluntary organisation known as River Flow Records, under the direction of Capt W N McClean, of Parliament Mansions, Victoria Street, S W 1 These observations have since been extended to cover the period from January to September inclusive, 1930, and the results relating to the river Garry are embodied in three quarterly reports recently issued The reports show that during the period in question, in addition to rainfall observation, there have been five months actually spent on river gauging work, with the design and construction of new gear for flood measurements and the erection and maintenance of water-level gauges Much useful and interesting data have been acquired and, for local, and even general reference, the statistical tables will be of great value The latest of the three reports provides an opportunity of comparing the flow and period losses of the two rivers, Garry and Moriston, over a full twelve months period, from which it may be noted that while both have catchment areas of 150 square miles, the twelve months' flow off of the Moriston is about 73 per cent of that of the Garry The 'period losses' in each case were fractionally above and below 14 inches The report concludes with some comments on the organisation required to maintain these records of flow after the actual gauging work is completed

A Gyroscopic Clinograph —Another interesting application of the gyroscope is the subject of an article entitled "Oil Well Surveying with the Gyroscope", in the November issue of the *Sperryscope*, the organ of the Sperry Gyroscope Company, Inc In the boring of oil wells many things lead to a deflection of the path of the drill from the vertical, and it is important to the driller that he should be informed of any such deflection There are several methods by which the angularity of an oil well can be determined, and some success was obtained with the use of the magnetic compass In conjunction with the Sun Oil Company, the Sperry Gyroscope Company has now brought out the 'Surwel' gyro

scopic clinograph. In this apparatus are incorporated a gyroscope with its axis set north and south, a box-level gauge, a chronometer, and a film camera, these parts being contained in a steel cylinder $5\frac{1}{4}$ in. in diameter, which can be lowered down the well. The bubble in the box level shows the inclination, a pointer on the gyroscope gives the direction of the inclination, while the camera, timed by the chronometer, takes a series of photographs of bubble, pointer, and chronometer hands. As the rate of lowering is known, the exact depth at which each camera observation is made can be found, and thus the inclination and its direction can be determined at any given depth. The data recorded on the film can also be plotted on squared paper and a graphic picture of the well's course through the ground can be obtained.

Loud Speaker Acoustics.—The design of commercial loud speakers is largely empirical and, indeed, a complete theoretical treatment of the problem is not yet possible. A number of important factors affecting the reproduction of speech and music by coil and reed driven speakers are discussed in a paper by N. W. McLachlan and G. A. V. Sowter (*Phil. Mag.*, **11**, pp. 1-54). It is shown that a *rigid* coil- or reed-driven disc system would be of little value in the reproduction of either speech or music. The energy from the coil-driven disc decreases very rapidly above 1000 cycles, whereas the energy from the reed-driven disc is centred round the resonance frequency of the combination. A reed-driven *flexible* disc fails as a reproducer, owing to prominent, widely spaced, natural frequencies due to the limited number of modes of vibration of the disc in the audible frequencies. Actual coil- and reed-driven diaphragms give better reproduction than would be expected from the rigid disc theory, and they possess an almost continuous succession of minor resonances. The theoretical conclusions are supported by experimental evidence. Measurements of the radial velocity of sound in discs were made, and it was found that near the periphery of a conical diaphragm the velocity is considerably less than in air. A summary of sixteen electrical, acoustical, and mechanical factors causing distortion in the reproduction by moving coil systems is given at the end of the paper and indicates the extreme complexity of the problem.

Records of Slow Electrons.—In a paper by P. H. Carr in the December number of the *Review of Scientific Instruments* an account is given of a very promising method for recording slow electrons of energy less than 100 electron volts. A piece of metal, which may be either in a massive form or a sputtered film, is mounted in the vacuum apparatus, in exactly the same position as a photographic plate would be. After exposure to the beam of electrons, the speed of which is readily controlled by magnetic sorting, the metal is treated chemically, when, with the appropriate reagents, a visible trace of the area of impact appears. Gold, silver, and zinc have been studied in the greatest detail; the best developing agents for the latent images were found to be mercury, iodine, and hydrogen chloride respectively, all in the vapour phase. Gold gives the greatest contrast if the images are to be reproduced afterwards by ordinary photography, but with silver striking colour effects can be produced, which are especially useful for demonstration of the effect. Zinc is the least trustworthy of the three metals, but when images are present on it, they are of excellent definition. It appears that although the technique involved is rather laborious, yet the method is less liable to failure with the slowest electrons than ordinary photography, whilst it has the great advantage that it is not subject to interference from light, either extraneous or from hot filaments within the apparatus.

Isotopes of Beryllium.—The element beryllium occupies rather an anomalous position in that it appears to be a simple element of mass 9, although, from the properties of other elements, it might be expected to have an isotope of mass 8. Evidence for the existence of this isotope has now been found by W. W. Watson and A. E. Parker, from a study of the band spectrum of beryllium hydride in the neighbourhood of 5000 A. (*Physical Review*, vol. 37, Jan. 15). When this is photographed in the third order of a 21 ft. concave grating, giving a dispersion of 1.3 A. per millimetre, every main line in a certain region is found to be accompanied by a weak satellite, and taking the main lines to be due to the molecule Be^9H, the satellites can be shown to be in the positions appropriate to Be^8H. The relative intensities of the Be^8H lines and the Be^9H lines are about 1 to 2000. These results, if substantiated, will confirm Lord Rayleigh's suggestion, which is based on the occurrence of unusually large quantities of helium in the mineral beryl, that a Be^8 nucleus is less unstable than has hitherto been supposed.

Organic Selenium and Tellurium Compounds.—The January number of the *Journal of the Chemical Society* contains two papers by Morgan and Burstall on *cyclo*-selenohexane and *cyclo* tellurobutane respectively. *Cyclo* selenohexane, containing Se interposed between two CH_2 groups in *cyclo* hexane, is a pungent smelling oil, obtained in small yield by the action of sodium selenide on $\alpha\zeta$ hexamethylene dibromide in alcoholic media, the main product being a mixture of at least two polymeric forms. It gives a crystalline mercurichloride, $C_6H_{12}Cl_2SeHg$, a dichloride, a dibromide, a di-iodide, and a methiodide, by direct addition. *Cyclo* tellurobutane, a five membered ring compound, was obtained by the interaction of tellurium with $\alpha\delta$-tetramethylene di-iodide at 130°, giving the *cyclo* telluributane di-iodide, which can be reduced to *cyclo*-tellurobutane, a pale yellow oil of repulsive odour which oxidises rapidly in air, the tellurium atom taking up an atom of oxygen. The cyclic tellurohydrocarbon forms very stable dihalides, the chlorine and bromine compounds crystallising unchanged from water. A mercurichloride and a methiodide were also prepared.

Distortion of Flame Surfaces in Electric Fields.—Guénault and Wheeler, in the January number of the *Journal of the Chemical Society*, describe some experiments on the effect of an electric field between two parallel metal plates on the propagation of a carbonic oxide flame initiated at the centre of a spherical bulb. The paper contains some excellent photographs of the flames produced, which show a decided effect of the field. There appears to be little or no alteration in the rate of growth of the flame in a direction transverse to the field. The field did not stimulate the growth of the flame between the plates in the direction in which electrons produced in the flame would be moving, so that such electrons do not appear to assist the propagation of the flame. The speed of the flame was, however, increased in the opposite direction, in which the positive ions are moved. There was also a bodily movement of the whole of the spherical flame surface in the same direction, and sometimes wholly away from the igniting spark. The movement in the opposite direction is, therefore, not only retarded but actually reversed by the field. This suggests that the movement of the flame surface may be mechanical, due to the movement of the heavy positive ions dragging the flame surface with them, and not necessarily the result of a stimulus to chemical activity imparted by the electric field.

Russian Scientific Workers in Foreign Laboratories.

NEVER before in the history of science has there been a case when hundreds of scientific workers have been exiled wholesale from their country, or have left it because they have found it impossible to continue scientific work there This is what happened in Russia after the Bolshevist revolution took place about ten years ago, scientific workers, with others, either had to submit to the new régime with its somewhat unusual views on the subject of the free dom of scientific thought, or to try to seek their fortunes elsewhere There are no statistics to tell us of the many who left their life's work and their homes behind them, only to fail in their hazardous attempts and to go down in the struggle for existence, but it is of great interest to learn that a large number of them succeeded in finding suitable occupation in various countries and have been able to continue their studies A good idea of their work can be obtained from the bibliography of books and papers published by Russian scientific workers abroad during the period 1920–1930, issued recently by the Russian Scientific Institute founded in Belgrade with the active support of the Jugoslavian government *

The volume contains no less than 7032 titles of books and papers published in 18 different languages by 472 Russian authors scattered all over the world, from Sofia to Stockholm, from Kharbin and Indo China to London and Paris, and from Chicago to Rio de Janeiro It is natural that the bulk of the titles are those of works on economics, sociology, history, philology, law, and other branches of the humanities, as well as engineering and other applied sciences, but there is an unexpectedly high percentage of works on the natural and exact sciences Their number is 1929 and they belong to 122 authors The list is headed by 596 works written by 38 authors on various prob lems of medicine and physiology, and an important place amongst them belongs to several former pupils of the famous I Pavlov, whose methods for the study of the physiology of the nervous system are now being developed by them in a number of laboratories in Europe and in the United States Nine Russian botanists published 121 works, amongst which the books of V V Lepeshkin on the chemical physiology of plants are well known to specialists Exiled geologists number 11, and there are such celebrities amongst them as the late N I Andrusov (Prague) and A Stebutt (Belgrade), the aggregate number of publications on geology reaching 102

* Materialy dlya bibliographii russkich utchenych trudov za rubezhom (1920–1930) Part I pp 394 Belgrade, 1931

Ten Russian zoologists and entomologists produced 250 books and papers, including a series of outstanding articles on comparative anatomy by M M Novikov (Prague), culminating in the book "Das Prinzip der Analogie und die vergleichende Anatomie" (Jena, 1930) Amongst entomological works, the world catalogue of Aphaniptera by J N Wagner (Belgrade) should be mentioned Microbiologists are only three in number, but the name of S Metalnikoff (Paris) will be familiar to most specialists in this branch, and the 115 papers produced by them represent a valuable contribution to a number of fundamental problems Russian chemistry, too, can be justifiably proud of the work of J I Bickermann (Berlin) and E Rabinovitch (Göttingen), to mention only two of the 13 chemists with their 133 publications, while 6 physicists published 101 papers, and 200 papers and books on mathematics and mechanics have been pro duced by 11 Russian workers There are only two Russian astronomers abroad, but their names are O Struve (Chicago) and V Stratonov (Prague), and they published 100 papers between them To com plete the list, 131 papers and books on geographical subjects written by 11 authors, and 80 publications by 9 authors on agriculture, appeared during the period under review

Striking though these figures are, they are very in complete, because the bibliography included only the works of those Russian scientific workers who sub mitted lists of their papers, many of them failed to do so for various reasons The editors, however, hope to publish supplements to the bibliography from time to time

It will be seen that many Russian scientific workers made full use of the opportunities offered them at various universities and laboratories, most of which have gladly opened their doors to their Russian colleagues

Apart from contributing to the progress of science by their own original work, Russian scientific workers are also doing a great service to men of science of other nations by making available to them the results of Russian researches, which remained largely unknown abroad, by reviewing current and past Russian literature in the respective fields It would probably not be an exaggeration to say that practically every bibliographical, or abstracting, periodical has now Russian experts on its staff, and this helps to make Russian scientific work available everywhere

B P U

The Constitution of Soluble Proteins.

THE *Comptes rendus des travaux du Laboratoire Carlsberg*, vol 18, No 5, 1930 (Copenhagen H Hagerup, 1930. 6 25 Kr), contains a long paper (in English) by Prof Sørensen on recent work on the soluble proteins considered in the light of his theory of reversibly dissociable component systems According to this, soluble proteins consist of a series of complexes or components, reversibly combined, A_x, B_y, C_z , these components being, for example, mainly polypeptides, but in other cases containing phosphorus, in each of which the atoms are linked by principal valencies, whereas the complexes them selves are held together comparatively loosely and reversibly by residual valencies The strength and nature of these residual valencies depend on the chemical composition of the component in question as well as on its physical properties—above all on its dimensions and the resulting shape and surface

Alterations in the composition of the solution (salt content, *p*H, alcohol content, temperature) may give rise to reversible dissociation of the component systems and interchange of components between them When these alterations in composition are so suited as to render possible the formation in sufficient quantities of a component system insoluble or spar ingly soluble under the new conditions, such a system will be formed and precipitated

It is not always easy to determine whether a given protein solution is a mixture or a true componen system Prof Sørensen shows that the results of hi investigations and his theory of reversibly dissociabl components are reconcilable with Svedberg's result on the molecular weights of proteins as found b the ultra-centrifuge method These show that onl a few proteins have molecular weights exceeding million, namely, the haemocyanins of the blood o

some snails The molecular weights of other proteins are, with one exception (casein, which contains protein molecules of various sizes), small multiples of about 35,000 Egg albumin and Bence Jones's albumin belong to the first group, with spheroidal molecules of radius 22 A and molecular weight 35,000 Hæmoglobin and serum albumin have non spheroidal molecules of weight 70,000, serum globulin belongs to the third group, with non spheroidal molecules of weight 105,000, and the fourth group, with spheroidal molecules of radius 40 A and weight 210,000, includes the vegetable proteins edestin, excelsin, and amandin The results for egg albumin, by very different methods, are unanimous, and everything seems to show that it is a simple chemical unit Serum albumin, on the other hand, has been fractionated Although the results of Svedberg and Sjögren gave a molecular weight of about 67,500, instead of the value 45,000 found by Sørensen, the latter does not think his product contained true decomposition products, since the fractions retained their marked power of crystallisation He considers that reversible dissociation only had occurred He makes a far sharper distinction, in this and other examples, between reversible dissociation and true decomposition of a protein than does Svedberg

The nature of peptic scission is considered at length, the conclusion being reached that the breaking of peptic linkages is the sole chemical process involved, the simultaneous marked change in physical properties being due to secondary processes (hydration and disaggregation)

The name 'component systems' is now preferred to that of 'co precipitation systems' introduced by Linderstrøm Lang, the name 'component' being used for an individual reversibly linked constituent The real character of the molecular weights found by Svedberg is accepted, and the 'average molecular weight' found for a mixture can give valuable information

In the experimental part, emphasis is laid on the importance of determining the distribution of the components of the dispersion medium between the solution and the undissolved phase, and a number of examples from previous memoirs, as well as new investigations, are summarised in this section Some tendency to reversible dissociation was detected with egg albumin Serum albumin was separated into three groups of fractions differing in solubility, irrespective of whether the fraction in question is phosphorus containing or not The various fractions differed very little in chemical composition, and two almost identically composed substances may be widely different in solubility, a result which is not due to denaturation Casein has a very considerable tendency to dissociation, but is not regarded as a mixture Its ionisability in presence of acid or alkali gives rise to component systems with a much greater dissociating tendency than that of uncharged or isoelectrically charged systems

The question of protein systems in serum is considered They are regarded as in continual mutual interaction, forming new systems, the composition of which depends on concentration and other conditions, and the proteins may not correspond with those precipitated by salts The question which this suggests, whether it is reasonable to retain the old terms serum albumin and serum globulin, is considered, the answer being in the affirmative

The interesting relation between lipoids and proteins in serum is discussed, particular attention being given to Mâcheboeuf's experiments The latter obtained from horse serum a product which he regarded as a chemical compound of lecithin, cholesterol ether, and protein, from which lipoids cannot be extracted by ether, and in which the protein is not, or is only slowly, denatured by alcohol at the ordinary temperature This conclusion is accepted, and it is suggested that the perfect clearness of such liquids as serum and plasma, in spite of their high lipoid content, is explicable only by assuming linkages between the lecithin and sterols on one side and the proteins on the other The linkage between lipoid and protein is weak and may be split in emulsification processes, a real chemical linkage is not probable

It will be seen from the above brief summary that Prof Sørensen's authoritative memoir raises many questions of considerable interest and importance, both from the chemical and the biological points of view, and it may be welcomed as a brief yet comprehensive summary of recent work in that branch of protein investigation to which its author has made so many important contributions

General Biology in the "Encyclopædia Britannica"

ANY criticism of the articles on general biology in the "Encyclopædia Britannica" must take into consideration, first, the fullness and accuracy of the information contained in them, and secondly, the mode of presentation For it is surely not sufficient to provide a summary, however authoritative, of any branch of science, if this is presented in such a manner that it cannot be understood by the general reader It is for his benefit that the "Encyclopædia" is, presumably, issued, and its financial success is certainly dependent upon his willingness to purchase it

There are some branches of physical science in particular which cannot be presented to the public in an intelligible manner Both the subject matter and language employed are alien But this has not in the past been true of biology Here the general reader has felt confident of understanding articles written about it It is in some degree a measure of the very definite advance which biology has made in the past generation that the general reader will not infrequently find these biological articles difficult of comprehension But the fault does not always lie solely in the subject matter, for several of the authors have shirked the admittedly difficult task of presenting their information in plain English and taken the easier way of scientific 'shorthand' The more intricate biology becomes, the greater the need for clear writing in articles such as these

It is pleasant to find, therefore, that the articles which will probably be most frequently consulted by the general reader, evolution by Prof E S Goodrich and zoology by Prof D M S Watson, are wholly admirable in both their scope and presentation No biologist can read them without having his ideas clarified, and no layman can fail to understand them or to be impressed by the range of knowledge they display The only criticism we have concerns the article on evolution Here the vital need, in Darwin's opinion, of natural selection as the mechanism which prevented the swamping, as he thought, of any favourable variation by promiscuous interbreeding, is not stated The reader is left with the impression that Darwin realised, as his successors do to-day, that there was such a thing as segregation which makes swamping impossible

Prof J B S Haldane has made the best of a very difficult task in his article on heredity It is not easy reading, but, in view of the nature of the facts with which it deals, this could not be avoided, and the

reader who takes the trouble to work his way slowly and carefully through this article will be repaid by the acquisition of a clear idea of the present state of knowledge on this subject, and also with a respectful feeling that biology *is* developing into an exact science The article is a thorough-going account of the modern developments of Mendelism, but, with all possible respect to the work which it summarises, one is left with a feeling of the immensity of the super structure which is now borne on the shoulders of the chromosome theory, and with a doubt as to whether some future edition of the "Encyclopædia" may not contain accounts of underlying principles of heredity as yet unsuspected

Prof F A E Crew also provides an excellent summary of modern knowledge on sex, but, with somewhat more tractable material at his disposal, he is not quite so successful in his presentation By some oversight, his long article contains no illustrative diagrams or graphs It is doubtful whether the general reader, however painstaking, will really acquire a clear idea of the subject from this article, but to the biologist it can be recommended as a masterly summary of the facts

Two articles, one on ecology by Mr C S Elton and the other on experimental embryology by Mr G R de Beer, bear testimony to the development of work on these subjects of recent years The general reader will find Mr de Beer's article full of surprising and unexpected information, and few biologists, outside the limited number who work on this subject, will fail to profit by the reading of it Mr Elton's article is interesting and well written but rather surprisingly long—the result, not of excess of knowledge, but of too little and a consequent lack of summarising generalisations But it is a little difficult to understand why this article should be so long, when Prof C Lloyd Morgan is so restricted in his article on animal behaviour that his statements are condensed almost to the point of being unintelligible

Prof J S Huxley gives most interesting and well-written accounts of the courtship of animals and of sexual selection, and Sir J Arthur Thomson is equally successful in his treatment of parasitism Indeed, all the articles on what might best be described as natural history are excellent

In his article on marine biology, Prof J Johnstone has largely confined himself to a clear but very general account of the different zones and conditions of life in the sea The general reader is unfortunately left largely in ignorance of some of the recent advances in this subject, notably on the factors which control the abundance of the plankton and its variations throughout the year and in different regions

It remains only to mention the articles on special groups of the animal kingdom, three of which, on protozoa, sponges, and tunicata, have been examined The information therein contained is as concise and authoritative as the names of the re spective authors, Dr K Bělar, Dr G P Bidder, and Prof W Garstang, would lead us to expect They all, in greater or less measure, give an account of the functioning of the animals, as well as of their structure and systematics, and so bear witness to the slow but ever increasing accumulation of knowledge which, as Prof Watson states in his article on zoology, is gradually building up a science of comparative physiology, of which, it may safely be prophesied, the next edition of this great "Encyclopædia" will have much to say

Fuel Research in Great Britain.

THE Report of the Fuel Research Board for the year ending Mar 31, 1930 (London H M S O, 1930, 2s net), is an interesting document, because it seems to touch upon almost every technical problem of fuel in the British Isles

One of the original plans of the Board was the pro secution of a survey of the national coal resources The report shows that the recent establishment of a labora tory at the University of Leeds to study the West Yorkshire coalfield brings under survey areas producing 96 per cent of the coal raised, and the remaining 4 per cent can be handled by the existing organisation The value of this work will be increasingly recognised as time goes on One example is given in the report, namely, the publication of a hasty survey of Scottish coals made during the War, when the need arose to increase the production of furnace coke in Scotland, and it was found that the data had to be sought as an emergency measure

The report gives a survey of the position of low temperature carbonisation, leading to the conclusion that its true place in the carbonisation industries cannot yet be defined, although several processes are being worked on a considerable scale and making good solid fuel products The world prices for oil fuels have fallen so much recently as to make the economic posi tion of these processes worse Motor spirit is the most valuable by product, but the yields of this are usually small, and the most hopeful line appears to be the conversion of a larger portion of the tar into this product The tars themselves have such a character that they are largely inapplicable for the purposes to which tars are normally used In order to find a basis for exploitation, their chemistry is being studied at the Chemical Research Laboratory, Teddington Two methods are suggested for promoting the utilisation of tar. The first is the use of 'cracking', following the practice of the petroleum industry, but the tendency to form large quantities of coke and gas is unfavourable to the use of these tars as 'cracking stock' Alternatively, the tars may be hydrogenated under pressure, which may be regarded as a form of 'cracking' in which coke formation is prevented by the union of hydrogen with the fragments Very interest ing experiments in this direction are recorded By means of controlled hydrogenation, it has been possible to convert nearly the whole of a low temperature tar into motor spirit and neutral oil—the yields of the former working out at 16 gallons per ton of coal carbonised The Admiralty staff has also examined the possibility of using low temperature tar oil as fuel for steam raising and for Diesel engines, with encouraging results

The hydrogenation of coal and its products is obviously a subject of great potential importance nationally and to the coal industry Though much has been done by private interests, the amount of authentic published experience is not great The report describes the results of experiments—both static and continuous—on the hydrogenation of coal With the use of suitable catalysts, it is found that Continental experience can be repeated with British coals and satisfactory yields of oil obtained The character of the product is such that its after-treatment is difficult A modification of the process, in which the coal is treated with a rapid stream of preheated hydrogen, has shown that much better products can thus be obtained Indeed, it is stated that yields of motor spirit up to 120 130 gallons per ton of coal could be realised in a suitable plant Another interesting scientific observation is the possibility of converting non-coking coal into coking coal by partial hydrogenation

Much is hoped from the use of pulverised fuel as a

means of promoting the use of coal on board ship In land practice, coal-dust firing has been made possible by the use of large combustion chambers, but at sea this is impossible In essence, the problem is to bring air for combustion into contact with finely divided suspended particles—a problem in aerodynamics which is being systematically studied By attention to these requirements very high rates of heat release in small burners have been obtained, which should contribute to the solution of this problem

The staff of the Board has carried out laboratory work on the properties of coal, and also supported investigations by independent workers in the universities and elsewhere who have originated special techniques Thus Mr C A Seyler has been enabled to develop methods for studying polished surfaces of coal by reflected light His work has recently been published as a special report Mr Lomax is studying the distribution of spores in coal seams by examination of their sections This work, in association with that of the South Yorkshire Survey Laboratory, suggests the possibility of identifying and correlating seams by identification of the spores contained Interesting work in association with the Building Research Station is reported which should place the calculation of the heat requirements of buildings on a quantitative basis

In conclusion it may be said that the report comments on so many points that the reader can gather from it a very good idea of the status of British fuel problems in general H J HODSMAN

University and Educational Intelligence

CAMBRIDGE —In a report of the Council of the Senate on the future of mineralogy, petrology, and crystallography in the University it is recommended that, upon the retirement of Prof A Hutchinson from the professorship of mineralogy, the professorship of mineralogy be discontinued, and that there should be established in the University a professorship of mineralogy and petrology, assigned to the Faculty of Biology "A", and that a department of the same title be constituted, to include also the subject of crystallography

The Council of the Senate recommends that the Downing professorship of medicine be discontinued

Mr H H Brindley, University demonstrator in zoology, has been elected to a fellowship at St John's College

LEEDS —Courses of lectures on literary and scientific subjects will be given in the University during the Easter vacation, on April 15, 16, and 17, 1931 The lectures are intended primarily to meet the needs of those who find it difficult to keep in close touch with recent developments, and will also give opportunities for discussion Graduates of the University of Leeds will be admitted free, but for others a fee of £1 will be charged The science courses include lectures on the electronic theory of valency and on modern views on colloids, acids and bases, and the ionisation of electrolytes, and on the relationship between philosophy and various aspects of natural science Applications for admission to the course should be sent not later than Mar 21 to The Registrar, the University, Leeds, and should be accompanied by a remittance where payable

LONDON —Mr W B R King has been appointed as from Aug 1 next to the Yates Goldsmid chair of geology tenable at University College Since 1922 he has been fellow and Charles Kingsley lecturer at Magdalene College, Cambridge.

A University (part time) chair of medical psychology tenable at the London School of Hygiene and Tropical Medicine is to be instituted

ST ANDREWS —The Court has approved generally plans prepared by Mr J D Mills for a new building to provide accommodation for the departments of botany and geology at St Andrews, to be erected adjoining the group of buildings presently occupied by the Bute Medical School and the Bell Pettigrew Museum Plans have also been approved for the adaptation of Deanscourt, St Andrews, as an additional residence hall for men students

Dr W F Harper, hitherto assistant in anatomy, has been appointed a lecturer in regional anatomy in the University

THE American University Union (British Division), which has recently moved its London office from Russell Square to 1 Gordon Square, W C 1, announces, in a leaflet entitled "14 Points", the nature of the service it offers to American students and to British university graduates and others interested in American universities It facilitates meetings of British scholars with Americans, supplies, upon request from British societies, American college lecturers upon American subjects, and keeps a register of applicants for university posts in the United States Through the Institute of International Education (2 W 45th Street, New York), which publishes a monthly *Bulletin*, it undertakes arrangements for exchange professorships, visiting professorships, and exchange scholarships between British and American colleges It maintains personal touch, by visits, with each of the universities in Great Britain and Ireland, and tells them of the ways and aims of education in America It keeps on file the latest calendars of all representative American colleges, and answers questions about them, put by British educational authorities It co operates with the Continental Division of the Union (173 Boulevard St Germain, Paris) in the endeavour to help visiting scholars to acquaintanceships in any educational centre in Europe The director is W Connely

UNIVERSITY education in India is briefly discussed in the official pamphlet, "Education in India, 1927–1928", recently published (Calcutta Gov India Cent Pub Branch, 1 12 rupees) The rate of increase in the number of students in universities and arts and professional colleges (0 8 per cent of the total number of scholars in all kinds of institutions) is recorded as 0 84 per cent in twelve months, during which time the total of scholars of all kinds increased by 5 5 per cent Expenditure on university and collegiate education, which is 13 per cent of the total expenditure on education, increased at the rate of 7 per cent, as compared with an increase of 5 per cent in the total expenditure on education of all kinds The Indian Institute of Science, Bangalore, with its 100 students, accounts for 1 5 per cent of the expenditure on university and collegiate education Of four of the seventeen universities—Allahabad, Andhra, Lucknow, and Madras—it is recorded that they have adopted the principle of compulsory physical training for their students There are two religious denominational universities, the Aligarh Muslim and the Benares Hindu To each of them the United Provinces Government gave a recurring grant of 50,000 rupees to enable them to maintain departments of, respectively, Unani and Ayurvedic medicine In another direction the Benares Hindu University has broken away from the traditions of Indian universities by providing advanced courses which prepare for industrial life, and its diploma in engineering is recognised by employers as a guarantee of a sound training in mechanical and electrical engineering

Birthdays and Research Centres

Mar 8, 1855 —Prof K E VON GOEBEL, For Mem R S, professor of botany in the University and Director of the Botanical Gardens, Munich

At present I am engaged on the preparation of a work on "The Flowering Shoot" (anthocladia and inflorescences) to be published this year as the second supplement to the "Organographie den Pflanzen", third edition My main interest is the biology and taxonomy of leptosporangiate ferns

A critical revision of phylogeny, especially a comparison of the results of the phyto palæontological discoveries with the modern views on the relationships in the larger natural groups of plants, for example, in ferns, is a problem deserving of the closest study

Mar 9, 1862 —Sir SIDNEY F HARMER, K B E, F R S, formerly Director of the Natural History Departments of the British Museum

My principal work, at present, is the preparation of Part 3 of my *Report* on the Polyzoa collected by the *Siboga* in the Malay Archipelago

I continue to keep in touch with recent developments of the subantarctic whaling industry Whaling operations have increased in magnitude to an alarming extent, particularly since the season 1926–27, and principally as the result of the increased use of pelagic 'floating factories' which operate on the high seas These ships, which have already reached a size exceeding 20,000 tons, are capable of performing all manufacturing operations on board They are under no effective control, and there is reason to believe that in some cases a regrettable waste of valuable material is taking place The production of oil, in these localities, has risen from less than 800,000 barrels in 1925–26 to more than 1,600,000 barrels in 1928–29, and more than 2,500,000 barrels in 1929–30 (6 barrels = 1 ton) Naturalists acquainted with the results of earlier hunting in other areas are convinced that the whale population of subantarctic seas, the last refuge of the great whales, will be gravely reduced, in the near future, unless it is found possible to secure international agreement to the regulation of the industry, on satisfactory lines

Mar 13, 1873 —Dr CHARLES S MYERS, C B E, F R S, Director of the National Institute of Industrial Psychology

Much of the research work on which my staff and I have been engaged during the past ten years at the National Institute of Industrial Psychology has been fundamentally concerned with the mental differences between individuals Undoubtedly it suggests a problem of vast magnitude for future solution, namely, what are the *physiological* differences with which these *mental* differences are associated? What, for example, is the physiological significance of the discovery that, during the menstrual period, the mental efficiency of some women is distinctly greater, in others less, while in many it is not appreciably changed, compared with other times? What, again, is the physiological significance of similarly wide individual differences in efficiency which appear to result from ultra violet radiation? And what is the physiological significance of the striking differences in various mental characteristics revealed by mental tests?

Clearly, conjoint physiological and psychological research is essential to ascertain what *bodily* differences, say in metabolism, blood composition, or endocrine activity, are responsible for the *mental* differences disclosed by the Institute's research work

Societies and Academies

LONDON

Royal Society, Feb 26 —**J C Eccles and Sir Charles Sherrington** Studies on the flexor reflex (1) Latent period A method for measuring the latent period of the flexor reflex is described The values obtained for the central reflex time range from 2 7σ to 4 35σ, and are in general agreement with the values calculated by Jolly and by Forbes and Gregg The central reflex time is shortened when the stimulus applied to the afferent nerve is strengthened The temporal dispersion of many reflex discharges is shown to be due, not to the discharge of more than one impulse from motoneurones, but to variations in the latent periods of the single responses of different motoneurones The latent period of the response to a centripetal volley is greatly shortened if another volley precedes it by certain intervals This shortening occurs at the expense of the central reflex time It is concluded that all the time is saved in the reduction of the normal 'synaptic' delay by facilitation If that is so, the actual conduction time through the spinal cord must be less than 0 5σ On the assumption that the normal 'synaptic' delay is due to time taken for a succession of excitatory impulses (owing to their temporal dispersion) to build up a c e s of threshold intensity, all the observations are satisfactorily explained The experiments support the conclusions that in the flexor reflex, centripetal impulses are not transmitted straight through the spinal cord, but at certain points ('synapses') they are transformed into an enduring excitatory condition, c e s, which may in turn set up fresh nerve impulses—the reflex discharge —(2) The reflex response evoked by two centripetal volleys When the interval between two centripetal volleys is short, the reflex contraction evoked by the second volley is due largely to the discharge of motoneurones which fail to respond to either volley alone The response of these motoneurones is due to summation of the subliminal excitatory effects of each volley In addition to this facilitation at short intervals, a centripetal volley gives rise to a period of unresponsiveness of motoneurones Three types of unresponsiveness have been met with (a) Recovery complete in less than 16σ (b) Recovery complete in less than 50σ (c) Recovery not complete for more than 80σ From theoretical considerations, the duration of the relatively refractory period following an antidromic volley (10 5σ) is likely to be identical with the duration of the relatively refractory period of the reflex arc —**J C Eccles** Studies on the flexor reflex (3) The central effects produced by an antidromic volley When a single stimulus is applied to an intact motor nerve, a volley of impulses (called an antidromic volley) passes into the spinal cord through the ventral roots A single centripetal volley gives rise to c e s during a considerable period Persistence of the c e s set up by such a volley is due partly to the temporal dispersion of the incident excitatory impulses and partly to the c e s produced by any particular impulse itself enduring for some time In any motoneurone an antidromic impulse removes preformed c e s —**J C Eccles and Sir Charles Sherrington** (4) After-discharge A period of quiescence follows an antidromic volley set up during the after discharge of a reflex either by a single centripetal volley or by a repetitive series of centripetal volleys (confirming Denny Brown) It is concluded that preformed c e s of a motoneurone is removed by a reflex discharge and has to be built up again by delayed excitatory impulses before another discharge can occur —**J. C Eccles and Sir Charles Sherrington** (5) General

conclusions A brief statement with discussion of various views of the nature of central excitation in reflex activity —**A V Hill and J. L Parkinson** Heat and osmotic change in muscular contraction without lactic acid formation Frogs' muscles poisoned with iodo acetic acid, in which no lactic acid is formed, when stimulated to exhaustion in nitrogen gave total heat 0 367 cal per 1 gm and showed a rise of osmotic pressure This change of osmotic pressure cannot be explained in full without assuming either (*a*) that some chemical reaction, hitherto unrecognised, occurs in such poisoned muscles when stimulated, or (*b*) that phosphagen (and perhaps adenyl-pyrophosphoric acid) exist not as simple molecules in the resting muscle but in some combined form

Society of Public Analysts, Feb 4 —**L H Lampitt and J H Bushill** The solubility of milk powder—the moisture factor The authors stress the complicated nature of the changes which take place when spray-dried milk powder absorbs moisture The freezing of the fat, whereby it is made available for solution in organic fat solvents, is one indication of the changes taking place above the 'critical moisture content', a figure dependent upon the solids not fat —**S Marks and R S Morrell** (1) The determination of the hydroxyl content of organic compounds estimation of castor oil Peterson and West's modification of the method of Verley and Bolsing, in which the hydroxyl content is determined by treatment with acetic anhydride and pyridine, was found the most satisfactory method, and is particularly suitable for the estimation of castor oil —(2) The determination of the carboxyl and aldehyde content of organic compounds estimation of phenylhydrazine The most suitable method was found to be that of Ellis, in which the substance is treated with excess of phenylhydrazine, and the nitrogen evolved on treating the excess with Fehling's solution is collected and measured in a simple form of apparatus, an allowance being made for the benzene vapour —**A Van Raalte and J Straub** Food control in Holland Food control in Holland is based on legal standards arrived at usually by agreement between the directors of the control service and the large manufacturers Not only foods, but also other commercial products such as toilet articles, wallpaper, insecticides, etc, are subject to control There is a right of inspection of premises where food is manufactured or sold, and this, coupled with intensive sampling, has reduced to 6 7 per cent, the percentage of samples falling below the standard —**H R Ambler** The determination of small quantities of methane The hydrogen and carbon monoxide are oxidised by means of cupric oxide at about 500° C, the resulting carbon dioxide removed, and the methane determined by burning with oxygen in the presence of platinum wire at bright yellow heat, and measuring the carbon dioxide produced and the residual oxygen —**R Bhattacharya and T P Hilditch** The fatty acids and component glycerides of Indian ghee Cow ghee gives figures falling within the limits previously recorded for English and New Zealand butter fats, but buffalo ghee showed rather higher Reichert-Meissl and Kirschner values It also contained more butyric and stearic acids than cows' butter

Geological Society, Feb 11 —**W J Arkell**. The Upper Great Oolite, Bradford Beds, and Forest Marble of South Oxfordshire, and the succession of gastropod faunas in the Great Oolite In the first part of the paper the principal exposures in South Oxfordshire of the uppermost beds of the Great Oolite and the Forest Marbles are described, with especial reference to the palæontological horizons, and for the first time the fauna of the highest portion (or Block I.) of the Great Oolite is enumerated and discussed It is shown that this fauna is essentially a Great Oolite one Secondly, it is demonstrated that the renowned fossil bed of Islip contains nearly the whole of the highly characteristic assemblage of the Bradford Clay, of which it is held to be a true representative In the second part of the paper the gastropod beds of the Great Oolite are studied, and an attempt is made to disentangle the various species and genera —**A Heard and J F Jones** A new plant (*Thallomia*) showing structure, from the Downtonian Rocks of Llandovery, Carmarthenshire The structures of the peculiar fossil were revealed by mechanical and chemical methods of treatment Horizon Lower Downtonian, probably a few yards above the Upper Ludlow—Downtonian junction Locality Long west 3° 41′, lat north 51° 58′ 35″

PARIS

Academy of Sciences, Jan 5 —**Auguste Lumière and Mme A Dubois** The distribution of Koch's bacilli contained in milk, after separating the butter and casein Known amounts of tubercle bacillus were added to milk, the cream separated, and the casein separated from the butter milk in the usual way The resulting whey and the cream were free from bacilli which appear to be concentrated in the casein It is concluded that starting with tuberculous milk the maximum danger is in the cheese —**J Herbrand** The units of an algebraical body —**J Rey Pastor** A characteristic property of the varieties of Jordan —**H F Bohnenblust and E Hille** The absolute convergence of Dirichlet's series —**L Tchakaloff** The theorem of finite increments —**Georges Bouligand** Cavities arising in a heavy liquid —**G Ribaud and P Mohr** The determination of the melting point of platinum The method adopted was optical extrapolation, starting with the melting point of gold The melting point found was 1762° ± 2° C —**Mlle M Chenot** A new appearance of the high frequency discharge —**G Ferrié** Remarks on the preceding communication —**Armand de Gramont** Transmitted light in the case of so called total reflection If a light pencil is reflected from the long side of a right angle prism, under an angle of incidence greater than the limiting angle, some light diffuses through the back of the prism and shows a maximum in a definite direction The intensity of this maximum depends on the polish of the reflecting surface —**Jean Loiseleur and Léon Velluz** The preparation of cellulose membranes containing proteins The solubility of some proteins (gelatine, casein, egg albumen) in anhydrous organic acids allows the preparation of true solutions of mixtures of proteins and cellulose derivatives, and from these, by evaporation, membranes of varying permeability can be prepared —**P Pingault** The iron carbide and iron oxygen equilibrium —**L Hackspill, A P Rollet, and L Andrès** The action of boric acid upon the alkaline chlorides and nitrates In the presence of steam, boric acid easily displaces the acid of alkaline chlorides and nitrates —**M Lemarchands and C Tranchat** The purification of disodium phosphate —**A Travers and Avenet** The determination of thiocyanates in coke oven effluents The thiocyanate is precipitated as cuprous thiocyanate, this dissolved in ammonia, oxidised to cupric salt, and titrated with potassium permanganate —**Mme Ramart-Lucas and J Hoch** The absorption spectra of dibenzyl and its derivatives A band attributed by previous workers to dibenzyl has been found to be due to the presence of a trace of stilbene as impurity —**A Marin and P Fallot**. The distribution of the facies in the Spanish Rif and their special character —**Pierre Dangeard** A parasitic *Ectocarpus* causing tumours in *Laminaria flexicaulis*

(*Ectocarpus deformans*) —**Robert Weill** The genus *Pteroclava*, the systematic interpretation of the Pteronemidæ and the taxonomic value of the cnidome —**Georges Fontès and Lucien Thivolle** Tryptophane and histidine are anabolites The simultaneous injection of tryptophane and histidine into dogs, in equilibrium with a fixed food ration, results in rapid gains in weight, and these gains are maintained for some time —**L Septilici** The diagnosis of syphilis by spectroreaction —**C Levaditi and P Lépine** The preventive action of liposoluble bismuth in experimental syphilis of the chimpanzee

Jan 12 —**A Guldberg** The problem of the scheme of urns —**David Wolkowitsch** The geometrical properties of ellipses of inertia of a plane system — **J A Lappo-Danilevski** The analytical coefficient of the singularities of integrals of systems of linear differential equations with arbitrary rational co efficients —**N Mouskhelichvili** New method of reduction of the fundamental biharmonic problem to an equation of Fredholm —**J Dieudonné** The radius of univalence of polynomials —**O Nikodym** Linear and continued functionals —**J Dufay and R Gindre** The variable star d-Cygni The variations of luminosity suggest the mutual eclipses of two stars moving in circular orbits and give a curve of the type of β-Lyrae A detailed spectroscopic study is required to elucidate the physical nature of the system of d Cygni —**Jean Ullmo** The application of classical statistical conceptions to wave mechanics —**H Muraour and G Aunis** The variation of $\int p\, dt$ with density of the charge for different types of (explosive) powders —**Charles Marie and N Marinesco** The phenomena of adsorption and protection in complex colloidal media —**Augustin Boutaric and Jean Bouchard** The acceleration produced by light in the flocculation of colloidal solutions in fluorescent media Suspensions of gamboge and resin (in presence of eosin and fluorescein) and of arsenic sulphide sols (in presence of eosin, fluorescein, and erythrosin) were used It was generally found that flocculation is accelerated by light in the absence of the fluorescent substance the flocculation was not accelerated —**G Chaudron and A Girard** The formation of a ferromagnetic iron sesquioxide by the decomposition of van Bemmelen's hydrated sesquioxide —**V Agafonoff** The influence of impurities on some physical and crystallographic properties of hemimellitic acid Some anomalies in crystal form and optical properties were traced to the presence of impurities, one being calcium hemimellate —**V Gouzien** The geological structure of the peninsula of Crozen (Finistère) —**M Gignoux and E Raguin** The stratigraphy of the Trias of the Briançonnais zone —**Ch Poisson and J Delpeut** Magnetic observations at Tananarive —**L Mercier** The hypopleural bristles of *Orygma luctuosa* and the principle of the connexion of the organs —**Mme Lucie Randoin and Mlle Andrée Michaux** Variations in the proportions of chlorine and of water in striated muscle, liver, and kidneys in the course of acute experimental scurvy At the time of appearance of the characteristic symptoms of scurvy, the proportion of chlorine in the muscles shows marked increase, from 0 5 per thousand to twice or even three times this amount, and this is due essentially to the deficiency in vitamin C —**Raymond-Hamet** The cardiac antagonism of pilocarpine and tropine —**Jean Régnier and Guillaume Valette** The influence of the concentration of hydrogen ions on the fixation of cocaine by adsorption on the nerve fibres. The experiments described lend support to the hypothesis according to which increasing alkalinity increases the anæsthetic action of cocaine hydrochloride, not only by modifying the physico-chemical properties of the anæsthetic solution in a sense favouring fixation, but also by reinforcing the power of fixation of the nerve cell itself —**P Delanoë** The sensibility of the fox to the Moroccan spirochæte, *Sp hispanicum* var *marocanum* Young foxes are frequently infected, but as adult foxes can show a very complete acquired immunity, the fox, like the porcupine, must be regarded as a reservoir of the virus

Official Publications Received

British.

The British Electrical and Allied Industries Research Association (Incorporated) Tenth Annual Report, October 1, 1929, to September 30, 1930 Pp 86 (London)

The Journal of Physiology Subject Index to Volumes 1 to 60. Pp iv+201 (London Cambridge University Press) 15s. net.

Navy (Health). Statistical Report of the Health of the Navy for the Year 1929 Pp 158 (London H M Stationery Office) 2s. 6d net

War Office Report on the Health of the Army for the Year 1929 (Vol 65) Pp iv+172 (London H M Stationery Office.) 3s net.

Canada Department of Mines Mines Branch The Salt Industry of Canada. By L Heber Cole (No 716) Pp viii+116+15 plates (Ottawa F A Acland) 20 cents

The Engineer Directory and Buyers Guide, 1931 Pp 260 (London)

Proceedings of the Cambridge Philosophical Society Vol 27, Part 1, January Pp 162 (Cambridge At the University Press) 7s 6d. net

The Journal of the National Institute of Agricultural Botany Vol 2, No 4 Pp 309 412 (Cambridge W Heffer and Sons, Ltd) 2s. 6d

Proceedings of the Royal Irish Academy Vol 39, Section B, No 28 A Statistical Analysis of the Laws governing the Urea Excretion in Man By Dr E J Conway Pp 574 594 (Dublin Hodges, Figgis and Co London Williams and Norgate, Ltd) 6d

C B C Bulletin No 2 Coital Interlocking, a Physiological Discovery By Dr Marie Carmichael Stopes Pp 6 (London Mothers Clinic for Constructive Birth Control)

Nigerian Forestry Department Bulletin No 1 Record of Forest Research in 1928 Pp 42 (Lagos C M S Bookshop, London The Crown Agents for the Colonies.) 5s

Journal of the Chemical Society January Pp iii + 228 + x (London)

Some Notes on the Cinchona Industry (Streatfeild Memorial Lecture 1930) By Bernard F Howard Pp 22+4 plates. (London Institute of Chemistry)

Journal and Proceedings of the Asiatic Society of Bengal New Series, Vol 25 1929, No 2 Numismatic Supplement for 1929 Pp 78+5 plates (Calcutta)

The Journal of the Botanical Society of South Africa Edited by R H Compton Part 16 Pp 30+8 plates (Kirstenbosch)

Quarterly Journal of the Royal Meteorological Society Vol. 57, No 238 January Pp. 116 (London Edward Stanford, Ltd) 7s 6d.

Transactions of the Institute of Marine Engineers, Incorporated Session 1930 Vol 42 January Pp 959 1044+xi (London)

Memoirs of the Indian Meteorological Department Vol 25, Part 6 The Wind at Agra and its Structure By Barkat Ali Pp 191 251+6 plates 2 14 rupees 5s Scientific Notes Vol 2, No 17 Tables of Monthly Average Frequencies of Surface and Upper Winds up to 8 Km in India Part A Pp 64 127 1 6 rupees 2s 3d Vol 2 No 17 Tables of Monthly Average Frequencies of Surface and Upper Winds up to 8 Km in India, Part B Pp 129 192 1 6 rupees 2s 3d. Vol 3, No 18 The Structure of the Madras Storm of January 1929 By Dr K R Ramanathan and A A Narayana Iyer Pp 12+11 plates. 1 10 rupees 2s 6d Vol 3, No. 19 Distribution of Air Density at M S.L over *India*. *By U N Ghosh Pp* 13 14+20 *plates* 1 4 *rupees* 2s (Calcutta Government of India Central Publication Branch)

Foreign

Scientific Survey of Porto Rico and the Virgin Islands Vol 6, Part 4 Botany of Porto Rico and the Virgin Islands. Supplement to *Descriptive Flora, Spermatophyta, Bibliography, Spermatophyta* and Pteridophyta, Index to Volumes 5 and 6 By N L Britton and Percy Wilson Pp. 521-668 2 dollars Vol 10, Part 4 The Ascidians of Porto Rico and the Virgin Islands By Willard G Van Name. Pp. 401 585 2 dollars Vol 12, Part 1 Insects of Porto Rico and the Virgin Islands Heterocera or Moths (excepting the Noctuidæ, Geometridæ and Pyralididæ). By W T M Forbes Pp. 174 2 dollars (New York New York Academy of Sciences.)

Meddelelser fra Kommissionen for Havundersøgelser Serie Hydrografi Bind 2, No 10 Contributions to the Hydrography of the Waters round Greenland in the Year 1925 By Baggesgaard Rasmussen and J P Jacobsen Pp 24 (København C A Reitzels Forlag)

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102 *Mededeelingen en Verhandelingen*, 29c Klimatologie van den Indischen Oceaan v Neerslag, vi Frequentie van Luchtdrukkingen en Stormachtige Winden, vii Tropische Cyclonen Door P H Gallé Pp. 31 (Amsterdam Seyffardt's Boekhandel.) 0.45 f

Proceedings of the Imperial Academy Vol. 6, No 9, November Pp xxvii xxviii+357 384 (Tokyo)

Science Reports of the Tokyo Bunrika Daigaku. *Section B*, Nos. 2-6 No 2 On Vector Quantity, 1 A Method of Vector Analysis with an Idea of Higher Complex Numbers, by Sumiinosuke Ono, No 3 On the Expression of the Transition Probability, by Usumi Doi, No. 4: Large Displacements in the Spectra of Ionized Nitrogen, by Kwan-ichi Asagoe No. 5 Some Peculiar Types of the Lichtenberg Figures, by Kwai Umeda and Mitsuo Shoyama. Pp 15-66+4 plates (Tokyo Maruzen Co., Ltd 75 sen

Meddelande från Lunds Astronomiska Observatorium. Ser 2, Nr 56 Stars with large Proper Motions in the A.G Zone of Lund (0^h 12^h). By W Gyllenberg Pp 17 (Lund C W K Gleerup.)

Memoirs of the Faculty of Science and Engineering, Waseda University, Tokyo, Japan. No. 7, 1930 The Collection of the Abridged Reports during 1927-1930 from Technical Chemical Laboratory, Waseda University Pp. v+146 (Tokyo.)

The University of Colorado Studies Vol 18, No 2 Abstracts of Theses for Higher Degrees, 1930 (University of Colorado Bulletin, Vol 30 No 11 General Series No. 286) Pp. 43 118 (Boulder, Colo)

Proceedings of the California Academy of Science, Fourth Series Vol 19 No 11 Marine Algæ of the Revillagigedo Islands Expedition in 1925 By William Albert Setchell and Nathaniel Lyon Gardner Pp 109 215 (plates 4 15) (San Francisco, Calif) 1 50 dollars.

Proceedings of the United States National Museum Vol. 77, Art 17 Studies of the North American Weevils belonging to the Superfamily Platystomoidea By W Dwight Pierce (No 2840.) Pp 34+5 plates Vol 78, Art. 10 A Revision of the North American Tachinid Flies of the Genus Achaetoneura. By R T Webber (No 2853) Pp 37 (Washington, D C Government Printing Office)

United States Department of the Interior Office of Education Bulletin, 1930 No 19 Accredited Higher Institutions, 1929-1930 By Ella B Ratcliffe Pp v+156 (Washington, D C Government Printing Office) 20 cents

University of Illinois Engineering Experiment Station. Bulletin No 213 *Combustion Tests with Illinois Coals, conducted by the Engineering Experiment Station University of Illinois, in coöperation with the* Zeigler Coal and Coke Company By Prof Alonzo P Kratz and Wilbur J Woodruff Pp. 58. 80 cents Bulletin No 214 The Effect of Furnace Gases on the Quality of Enamels for Sheet Steel , a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Utilities Research Commission By Prof Andrew I Andrews and Emanuel A Hertzell Pp 29 20 cents Bulletin No 216 Embrittlement in Boilers , a Report of an Investigation *conducted by the Engineering Experiment Station, University of Illinois*, in coöperation with the Utilities Research Commission By Prof Frederick G Straub Pp 125 65 cents (Urbana, Ill)

Catalogues

English Literature, including First and Early editions, Association Books Autograph Letters, etc (Catalogue 360) Pp 98 (Cambridge W Heffer and Sons, Ltd)

Catalogue of *Important Books on Botany, Horticulture, Zoology and Geology* (No 15) Pp 16 (London John H Knowles)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient (No 16) Pp 503 580 (Paris Libr Adrien Maisonneuve)

Colorimeters (List No 92.) Pp 24 Microscopes and Accessories List No 91) Pp 56 Electro chemical Apparatus embodying Electro Analysis of Metals Electrometric Determination of Hydrogen Ions and Conductivity of Electrolytes (List No 80c) Pp 44 (London A Gallenkamp and Co , Ltd)

The Products and *Aims of the* Firm of Adam Hilger, Ltd Pp 33 The Cubic Crystal Analyser (S B 136) Pp 7 Hilger X Ray Crystallograph for the Analysis of Substances having Crystalline Structures Pp 10 (London Adam Hilger Ltd)

Diary of Societies

FRIDAY, March 6

Royal Society of Medicine (Otology Section), at 10 30 A M —E D D Davis and others Discussion on Effects on Hearing after Fractured Base of the Skull Lessons Resulting Therefrom

Royal Sanitary Institute (at Guildhall, Swansea), at 3 —H R Tighe and others Discussion on The Rheumatic Child —Dr J M Morris E Morgan, and others Discussion on Housing

Royal Society of Medicine (Laryngology Section), at 5

Physical Society (at Imperial College of Science), at 5 —Dr G M B Dobson A Photoelectric Spectrophotometer for Measuring the Amount of Atmospheric Ozone —G F Tagg Practical Investigations of the Earth Resistivity Method of Geophysical Surveying —W E Pretty Displacement of Certain Lines in the Spectrum of Ionised Oxygen (O II, O III), Neon (Ne II), and Argon (A II)

Royal College of Surgeons of England, at 5 —Sir Arthur Keith Demonstration of the Nerve Supply of the Alimentary Tract and the Nature of Auerbach s Plexus

Society of Chemical Industry (Glasgow Section) (in Grosvenor Restaurant, Glasgow), at 6.45 —Annual Business Meeting

Society of Dyers and Colourists (jointly with Society of Chemical Industry) (at Engineers Club, Manchester), at 7 —S. M Neale The Action of Caustic Soda on Cellulose.

Institution of Electrical Engineers (Meter and Instrument Section), at 7 —J Urmston The Electrical High Pressure Testing of Cables and the Localisation of Faults.

Junior Institution of Engineers (at Science Museum), at 7 —The Historic Locomotives at the Museum

Institution of Mechanical Engineers (Informal Meeting), at 7 —A M Ling The Netherlands East India State Railways and Electrification (Lecture).

Royal Photographic Society of Great Britain (Pictorial Group), at 7 —Informal Meeting

Geologists' Association (in Architectural Theatre, University College), at 7 30.—Dr. C A. Matley The Deserts of California (Lecture).

Royal Institution of Great Britain, at 9 —Dr G M B Dobson Ozone in the Upper Atmosphere and its Relation to Meteorology

SATURDAY, March 7

Royal Society of Medicine (Anæsthetics Section) (at Bristol University), at 2.—Dr M Nierenstein, A. L Taylor, Prof R J Brocklehurst, A. L. Flemming, S. V Stock, Dr H. W Featherstone, Dr I W. Magill Symposium on the Barbiturates in Anæsthesia

Royal Institution of Great Britain, at 3 —Lord Rutherford : Recent Researches on the Alpha Rays (1).

Institute of British Foundrymen (Lancashire Branch) (at College of Technology, Manchester), at 4 —H G Scott The Blast Furnace, its Limitations and its Relation to the Cupola

Institute of British Foundrymen (Scottish Branch) (at Royal Technical College, Glasgow), at 4 —M Russell Pattern making and its Relation to Design and Foundry Practice

Institute of British Foundrymen (West Riding Branch) (at Technical College, Bradford), at 6 30 —H W Swift Commercial Tests for Cast Iron

MONDAY, March 9

Cambridge Philosophical Society (in Cavendish Laboratory), at 4 30 —Dr E D Adrian Electric Charges in Nervous Tissues — *Papers to be communicated by title only* —W N Bailey Some Series and Integrals Involving Associated Legendre Functions —J A Todd The Groups of Symmetries of the Regular Polytopes —H S M Coxeter The Densities of the Regular Polytopes —L Roth Some Properties of Line Congruences —W H Ingram Note on the Operability of Synchronous Motor at the End of a Transmission Line —R. H Fowler A Note on Ferromagnetism —F W G White A Theoretical Discussion of the Electrical Properties of the Soil —Dr T M Harris *Rhætic Floras* —Prof L Hogben *Some Biological Aspects of the* Population Problem —Dr V B Wigglesworth The Respiration of Insects

Royal Society of Medicine (United Services Section), at 5 —Squadron Leader H L Burton and others Discussion on Minor Head Injuries

Royal College of Surgeons of England, at 5 —C E Shattock Demonstration of Specimens illustrating Diseases of the Colon and Rectum

Institution of Automobile Engineers (Birmingham Centre) (at Queen s Hotel Birmingham), at 7 —J E Arrowsmith *Pressings for Automobiles*

Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College Newcastle upon Tyne) at 7 —J W Rissik and H Rissik Heavy Duty Rectifiers and their Application to Traction Sub stations

Institute of Metals (Scottish Section) (at 39 Elmbank Crescent, Glasgow) at 7 30 —Annual General Meeting

Royal Society of Arts at 8 —A. G D West The Recording and Reproducing of Sound (Cantor Lectures) (1).

Royal Geographical Society, at 8 —Major R. W G Hingston Proposals for British National Parks in Africa

Chartered Surveyors Institution at 8 —G Lovegrove The Amendment of the London Building Acts

Eugenics Society (at 20 Grosvenor Gardens S W 1), at 8 15 —Study Circle.

TUESDAY, March 10

Royal College of Physicians of London, at 5 —Dr M Critchley The Neurology of Old Age (Goulstonian Lectures) (1).

Royal Institution of Great Britain, at 5 15 —Dr C D Darlington The Cytological Theory of Heredity and Variation (1)

Institution of Civil Engineers, at 6

Institute of Marine Engineers, at 6.—G S Baker The Efficiency and Steering Effect of Inward and Outward Turning Screws

Institute of Metals (Swansea Section) (at Y M C A., Swansea), at 6 15 —Prof F C Thompson Some Researches on the Wire Drawing Process

Eugenics Society (at 20 Grosvenor Gardens, S W 1), at 6 30 and 8 30 — Study Circle

Society of Chemical Industry (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6 45 - E C F King Rust proofing of Iron and Steel

Institution of Electrical Engineers (North Western Centre) (at Engineers Club, Manchester) at 7 —P J Ryle Two Transmission Line Problems Suspension Insulators for Industrial Areas in Great Britain Conductor Vibration

Royal Photographic Society of Great Britain at 7 —Annual General Meeting

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7 —H R. Hiscott Malleable Fittings.

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Section) (at Borough Polytechnic), at 7 —H L. Egerton Domestic Hot Water Supply

Institution of Electrical Engineers (Scottish Centre) (at 39 Elmbank Crescent, Glasgow) at 7 30 —E T Norris and F W Taylor High Voltage Testing Equipments —B L. Goodlet, F S. Edwards, and F R Perry Dielectric Phenomena at High Voltages

Institute of Metals (North East Coast Section) (Annual General Meeting) (at Armstrong College, Newcastle upon Tyne), at 7 30 —R D Burn The Longmaid-Henderson Process *for the Extraction of* Copper

Quekett Microscopical Club (at 11 Chandos Street, W 1), at 7 30.— C D Soar British Acarina

WEDNESDAY, March 11

Institution of Engineering Inspection (at Royal Society of Arts), at 5 30 —Lt Col J T C Moore Brabazon Motor Racing and its Influence on Technical Design

Institute of Fuel (at Chemical Society), at 6.—J Roberts Formation of Coke.

North East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall, Newcastle-upon Tyne), at 7 15.— R Harding The Automatic *Stabilisation of Ships.*

Royal Society of Arts, at 8.—A. J Davis Architectural Decoration

Eugenics Society (at Linnean Society), at 8.30

Television Society (at University College).

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—E. W. Fish: On the Reaction of the Dental Pulp to Peripheral Injury of the Dentine.—E. B. R. Prideaux: The Combination Curves, Hydrogen Ion Regulating Power and Dissociation Constants of Gelatin.—R. Snow: Experiments on Growth and Inhibition.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. G. Bickley: Some Integrals Involving the Jacobian Zeta Function, and the Sums of Certain q Series.—H. S. M. Coxeter: Groups whose Fundamental Regions are Simplexes.—C. Fox: An Integral Transform and Some Applications.—S. Goldstein: A Note on Certain Approximate Solutions of Linear Differential Equations of the Second Order.—F. H. Murray: Asymptotic Dipole Expansions for Small Horizontal Angles.—R. Wilson: Eliminants of Characteristic Equations.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. M. Critchley: The Neurology of Old Age (Goulstonian Lectures) (2).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: Respiration (4).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. W. Rissik and H. Rissik: Heavy Duty Rectifiers and their Application to Traction Substations.

ROYAL AERONAUTICAL SOCIETY (jointly with Institute of Transport) (at Royal Society of Arts), at 6.30.—Capt. O. Florman: Night Air Mails.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—H. R. Tyrrell: Experiences of a Junior Engineer on his First Voyage.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—J. Kwantes: Chemistry in Beet Sugar Manufacture.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—Dr. A. B. Everest: Cast Iron To-day.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—O. G. Morgan and Dr. C. P. Symonds: Unilateral Ophthalmoplegia with Absent Tendon Jerks.—Dr. R. Brain: Grasp Reflex in the Foot.—Cinematographic Demonstrations.—Dr. S. Barnes: A Case of Unusual Dissociation of Voluntary Eye Movement.—Dr. H. Cohen: Technique and Results of Encephalography and Ventriculography.

FRIDAY, MARCH 13.

BIOCHEMICAL SOCIETY (Annual General Meeting) (at University College), at 3.—Prof. C. Lovatt Evans, Chiao Tsai and F. G. Young: A Note on the Estimation of Liver Glycogen.—R. A. McCance and H. L. Shipp: The Colorimetric Determination of Sodium.—E. Stedman and Ellen Stedman: Studies on the Relationship between Chemical Constitution and Physiological Action. Part III. The Inhibitory Action of Certain Synthetic Urethanes on the Activity of Liver Esterase.—B. C. J. Knight: An Electrolytic Method for Poising the Oxidation-reduction Potential of Culture Media.—G. F. Marrian: Observations on the Physiological Potency of Crystalline Tri-hydroxy Œstrin.—Prof. T. P. Hilditch and J. J. Sleightholme: The Glyceride Structure of Butter Fats.—H. R. Ing and R. N. Kekwick: A Note on Acyl Derivatives of Creatine and Creatinine.—I. S. MacLean and M. S. B. Pearce: Oxidations of Oleic Acid *in vitro* and their Bearing on the Biological Oxidation of Oleic Acid.—C. Rimington and A. M. Stewart: A Pigment from the Suint (Sweat Fraction) of Raw Sheep's Wool.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Dr. H. H. Mann: The Tea Industry of India in its Scientific Aspects.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Sir A. S. Eddington: A Theorem concerning Incomplete Polytropes.—J. Young: Occultations of Stars by the Moon observed at Birmingham University during 1930.—T. Matukuma: Relativity Effect in the Problem of Latitude Variation.—J. Dufay: Effect of Atmospheric Absorption in Stellar Spectrophotometry.—J. H. Hindle: A New Test for Cassegrain and Gregorian Secondary Mirrors.—V. V. Narlikar: The Significance of Bode's Law in Relation to Satellite Systems.—L. H. Thomas: The Slow Contraction and Expansion of a Fluid Sphere. II. Stability.—S. Chandrasekhar: The Dissociation Formula According to the Relativistic Statistics.—O. S. Beals: Wave Lengths of Oxygen and Nitrogen Lines in the Stellar Region.—Royal Observatory, Greenwich: Observations of Solar Flocculi made with the Spectrohelioscope during 1930.—Dr. H. H. Plaskett: The Formation of the Magnesium b Lines in the Solar Atmosphere.—B. Strömgren: The Possible Solutions of the "Equations of Fit" on the Standard Model.—T. G. Cowling: Note on the Fitting of Polytrope Models in the Theory of Stellar Structure.—S. Chandrasekhar: The Highly Collapsed Configurations of a Stellar Mass.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Anatomy, Physiology, and Pathology of the Œsophagus.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—S. F. Dorey: Some Factors Influencing the Sizes of Crankshafts for Double Acting Diesel Engines.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—C. J. F. Tweed: Aspects of the Transmission and Reception of Still Pictures.

INSTITUTE OF FUEL (North Western Section) (at Engineers' Club, Manchester), at 7.—Dr. G. E. K. Blythe: The Industrial Application of Pulverised Fuel.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. F. A. Mason: Recent Lines of Advance in Lake and Pigment Chemistry.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—L. Clegg: Phenol Formaldehyde Moulding Compositions: Manufacture and Use.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—W. J. Rees: The Manufacture of Lime.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. C. Squire: Parody.

SATURDAY, MARCH 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford: Recent Researches on the Alpha Rays (2).

ANNUAL MEETING.

MARCH 11 AND 12.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M., etc.

Papers to be submitted:

S. L. Archbutt and W. E. Prytherch: Investigation of the Effect of Impurities on Copper. Part VII. The Effect of Antimony. Part VIII. The Combined Effect of Antimony and Arsenic.

L. J. Brice: Some Properties of Silicon-Aluminium Bronzes.

Capt. W. F. Collins: The Corrosion of Early Chinese Bronzes.

Dr. P. J. Durrant: The Constitution of the Cadmium Rich Alloys of the System Cadmium-Silver.

Dr. C. F. Elam: An Investigation of the Microstructures of Fourteen Silver Greek Coins (500-300 B.C.) and some Forgeries.

O. W. Ellis: The Rolling of Alloys of Copper and Phosphorus containing up to 5 per cent of Phosphorus.

Dr. H. J. Gough and H. L. Cox: The Mode of Deformation of a Single Crystal of Silver.

J. D. Grogan and D. Clayton: Dimensional Stability of Heat-treated Aluminium Alloys.

Prof. D. Hanson: The Flow of Aluminium at Elevated Temperatures.

T. P. Hoar and R. K. Rowntree: Note on the Silver Rich Aluminium-Silver Alloys above 600° C.

Dr. C. H. M. Jenkins: Some Properties of Metallic Cadmium.

Dr. K. L. Meissner: The Effect of Artificial Ageing upon the Resistance of Super Duralumin to Corrosion by Sea Water.

C. E. Pearson and Dr. J. A. Smythe: The Influence of Pressure and Temperature on the Extrusion of Metals.

Dr. D. Stockdale: The Solid Solutions of the Copper-Silver System.

PUBLIC LECTURES.

FRIDAY, MARCH 6.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. H. Wieland: Studies on Biological Oxidation (Pedler Lecture).

SATURDAY, MARCH 7.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Mediæval Maps and Travellers' Tales.

MONDAY, MARCH 9.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 2.—T. D. Young: Meat Inspection.—At 5.—J. C. Dawes: Public Abattoirs: Lay-out, General Arrangement, etc.

LONDON SCHOOL OF ECONOMICS, at 5.—Rev. Edwin W. Smith: The Application of Social Anthropology to Practical Affairs. (Succeeding Lectures on Mar. 10 and 11.)

TUESDAY, MARCH 10.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15.—Dr. E. W. Hurst: Dessеminated Encephalomyelitis following the Exanthemata (Vaccination, etc.).

KING'S COLLEGE, LONDON, at 5.30.—Prof. G. Dawes Hicks: Sense Perception and Physical Thing.

WEDNESDAY, MARCH 11.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Dame Louise McIlroy: Maternal Mortality (Chadwick Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street, W.1), at 5.30.—E. Torday: The Things that matter to the West African.

KING'S COLLEGE, LONDON, at 5.30.—Prof. E. G. R. Taylor: The Great Age of Discovery: The Northern Passages.

THURSDAY, MARCH 12.

UNIVERSITY COLLEGE, at 5.30.—Dr. A. M. Bassani: Pompei (in Italian).

TEXTILE INSTITUTE (London Section) (at Barrett Street Trade School, W.1), at 7.—Sir Francis Goodenough: Salesmanship.

FRIDAY, MARCH 13.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 3.—Prof. E. Mellanby: Diet and Health (Sir Charles Hastings Lecture).

SATURDAY, MARCH 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Augustan Age.

CONFERENCE.

FRIDAY, MARCH 6.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting).

Friday, Mar. 6 (at Hotel Victoria), at 11 A.M.—Presentation of the Osborne Reynolds Medal, the Moulton Medal, and the Junior Moulton Medal.

At 11.45 A.M.—The President and others: Discussion on The Education and Training of the Chemical Engineer.

At 2.15.—Dr. D. M. Newitt: The Flow of Gases at High Pressure through Metal Pipes.

CONVERSAZIONE AND EXHIBITION.

SATURDAY, MARCH 7.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.

SATURDAY, MARCH 14, 1931.

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Industry and Scientific Research.

THE close relation between the dyestuffs industry and general organic research emphasised in the course of recent Parliamentary debates on the Dyestuffs (Import Regulation) Act was not controverted by those who considered that the Act should be allowed to lapse On the other hand, doubts as to whether Imperial Chemical Industries, Ltd, by which the major proportion of dyestuffs research in Great Britain has been conducted, was doing so much for research as might be expected, and a suggestion that such research was being or might be curtailed, were alleged by certain members as reasons for not voting for a measure which they would otherwise have supported The report of the Dyestuffs Development Committee, indeed, shows that there has been a slight decrease in the number of research workers employed in the dyestuffs industry between 1920 and 1928 This difference, however, as Major A G Church has pointed out, is largely due to the attraction of such research workers into other industries Apart from this, the figures given in the report are too early to record the full effect of the extension of research activity in this field which has resulted from and only become possible through the pooling of resources following the formation of Imperial Chemical Industries, Ltd

The relation between industry and research is extremely complicated, and there are certain aspects which were by no means covered in the recent debates and discussions It must be conceded that industrial research inevitably has an economic trend, which may at times impose limitations There is a certain amount of justification for making research obligatory when State support is given in any form On the other hand, the prosperity of the dyestuffs industry and the organic chemical industry depends essentially upon continuous and wisely directed research Any relaxation of effort in that direction would speedily result in decay It is open to debate whether any stipulation regarding research could be made without involving machinery for control which would be a serious hindrance to scientific management

The problems raised are not peculiar to Great Britain Prof R Willstatter has recently directed attention to the changed relations between the universities and chemical industry in Germany (*Chem Zeit*, **54**, 793, 1930, **55**, 1, 1931), and views with serious concern the increasing difficulty with which the newly qualified chemists are absorbed into industry and their insecurity of tenure Such conditions he regards as dangerous to the scientific

position of Germany, which cannot be maintained if students of ability are no longer freely attracted by scientific studies and careers

The opinion has been expressed that the world is suffering from over-production of chemists and of research, in common with over-production of all kinds This view is probably encouraged by the common impression that there are now no striking advances to be made in the field of organic chemistry, pure or applied Its main principles have in general been discovered, and the research chemist, whether in industry or in scientific laboratories, is now occupied with the intensive study of relatively small parts of the field

While the apparent orderliness of the immense edifice developed from Kekulé's theory undoubtedly strengthens the impression that chemistry is a static science, such a view is fundamentally false If propounded twenty or thirty years ago, since when the main structure of theoretical organic chemistry has remained essentially unchanged, this view would have been confounded by subsequent discoveries and advances in almost every branch of organic chemistry Well within these three decades we have seen the development of the rayon industry, the synthetic resins industry, the cellulose lacquer industry, oil-cracking, and low temperature carbonisation Immense developments have been recorded in the production of insecticides and synthetic drugs and in the vulcanisation of rubber The technical production of indigo essentially dates from the Deutschen Gold- und Silberscheideanstalt or Roessler sodamide fusion patent of 1901, the Sandmeyer process from thiocarbanilide being still more recent Moreover, within this period there is scarcely one of the older fields which can be described as exhausted or failing to produce fresh wealth The oldest section of the dyestuffs field, the triphenylmethane or aniline colours, formerly regarded as comparatively fugitive, was found in 1915 to be capable of yielding with phosphotungstic acid a series of lake or pigment colours of surpassing light fastness, whilst the azo section is still providing new dyestuffs to overcome the dyeing difficulties presented by the new rayon fibres

Although many of the branches of organic chemical industry have sprung from the discoveries, often fortuitous, made in scientific laboratories—as, for example, Perkin's mauve, Griess's azo dyes, Baeyer's phthaleins and synthetic indigo, Knorr's antipyrine, Ehrlich's salvarsan, the nitrocellulose silk of Count Chardonnet, the viscose of Cross—the significance of such discoveries was frequently unrealised at the time either by scientific workers or industry This alone should make us cautious in advocating any restriction of research There are too many problems in our national and industrial life urgently demanding scientific solutions for such a policy to be either timely or wise It is almost impossible to predict just where the next important advance will be made, or, in reviewing the results of a year's investigations, to single out the one discovery by which posterity will mark the year

The influence of industry on scientific research is, however, fully as important as that of scientific research on industry Even in the field of technique it is impossible to assess the contributions of either on a cash basis The greater resources of the industrial research laboratory and its improved and frequently more advanced technique are continually reacting on scientific laboratories The range of reaction conditions open to the organic chemist has enormously expanded in the last decade, and processes can now be effected in extremely high vacuum or under pressures of several thousand atmospheres and at temperatures ranging from the neighbourhood of absolute zero to those of the electric furnace, whilst the activators or catalysts available range from the new organic catalysts, bordering on biochemistry, over almost the whole field of inorganic chemistry

Nor is it only refinements of technique that are continually changing the conditions of scientific and industrial research Almost every year sees fresh compounds, formerly curiosities and accessible only by tedious and costly laboratory processes, produced on the commercial scale at a price which allows their use in industry or in scientific laboratories as the raw material of further researches The papers published in the journal of any chemical society reveal the way in which the scope of scientific research has been enlarged and influenced by industrial advances The utilisation of waste materials, the delicate balance between by product and main-product, the fall or rise in price of basic materials like sulphuric acid, methyl alcohol, glycerol, which alone may result in new routes for existing products—the war-time shortage of sulphuric acid, for example, led to the development of alternative processes for phenols and amines which have not been entirely replaced by the earlier methods—these are factors which continually emphasise the dynamic character of industrial research and frequently have far reaching effects on scientific research

If, however, the increasing complexity of the field of organic chemistry makes restriction of re

search inconceivable, the demands made on leadership are increasingly severe It was never easier than to-day for research ability to be wasted in an attack on unprofitable problems Scientific progress has almost invariably come from the ideas and work of a talented few, and depends as much upon the quality and personality of the investigator as upon his technique The most serious problem is the production of research leaders of the requisite imagination, foresight, and enthusiasm to direct wisely the team work which modern industrial research demands Any circumstance, whether of rates of pay, status, or insecurity of tenure, which hinders the recruitment for industrial research of potential leaders of the requisite calibre is a national and not merely an industrial danger There is little doubt that if the concentration of professional opportunities within at most one or two firms, as in Germany, does affect adversely the position and prospects of chemists, industry will quickly suffer from the reaction

The distinction between scientific and industrial research to-day is not easy to define Their relationship is dynamic and so intimate that circumstances which injure or cramp one react likewise on the other neither can advance while the other is starved, and on this fact Prof Willstatter based his plea for more generous assistance for the German universities from chemical industry Such assistance is now being given more freely in Great Britain, and the closer relationship between the universities and industry are undoubtedly to their common advantage

It is easy, however, to overstress from either side the economic aspects of the relation between industry and scientific research If there are ways in which scientific research cannot compete with industry, there are still inestimable services which scientific research can render to the nation as well as to industry Scientific research, in its freedom from the economic motive, can do much to counteract that tendency in industry for the good to be the enemy of the best, and to secure our advance to the best of all possible solutions Scientific research, in the widening fields opened to it by industrial developments, can use its resources to explore the byways, the economically unattractive fields from which will come in the future, as they have so often in the past, the fundamental and epoch making discoveries On such workers, too, in their quest of truth for truth's sake, must ever fall the responsibility of kindling and rekindling that enthusiasm and devotion to which alone Nature yields her most precious secrets

Faraday's Worth in Wisdom

A Tribute to Michael Faraday By Rollo Appleyard Pp xiii + 204 + 21 plates (London Constable and Co , Ltd , 1931) 7*s* 6*d* net

"A magnet hung in a hardware shop,
(said it) If I can wheedle
A knife or a needle,
Why not a Silver Churn ?"

HOW this was to be done was shown at the Royal Institution, ages before Gilbert stated the fable of the magnet and the silver churn and knowing no physics gave it the wrong 'moral'

The industrial value of Faraday s discoveries has long been patent, throughout the civilised world little heed has yet been given to the example he set and to the spiritual doctrine he professed Perhaps, in near days to come, hastening as we now are the exhaustion of natural resources, through disproportionate use of machinery and greed of gold, his spiritual legacy may be of more value to us in overcoming and directing the crude, untamed human nature within us, which our modern advance in knowledge serves but to cover with a thin veneer In celebrating in September, this year, the centenary of his greatest discovery, we shall do well to consider his moral worth and teaching at least as fully as his contributions to knowledge Something we must do to save the world from government by *Alfalfa Bills* and Oklahoma waste of oil (*Times*, Feb 17, 18)

The appearance of Mr Appleyard's book is opportune He has not only sought out particulars of Faraday s forebears in their north country homes and of Faraday's father at his Newington, South London, forge but has also delved into Royal Institution archives and elsewhere thus garnering not a few items of interest which are welcome additions to the story of the immortal scientific magician He also has an interesting chapter touching on Clerk Maxwell's work in connexion with Faraday, as the mathematical exponent of its meaning The book is one to ponder well Various arresting moments in the philosopher's life are dealt with in a way that will appeal to all who can appreciate the charm of Mr Appleyard's style and his sympathetic attitude towards his subject We can picture him, upon an Athenæum sofa, browsing in search of inspiration We can ourselves browse with delight upon the lawn which he has consequently laid out for us as sward it would scarcely appeal to the Sutton firm , the herbage is more that of a Swiss upland pasture, in which gentian blue is mixed with anemone

yellow, set off with multi-coloured pansies and occasional red silene.

With such an example before them, the Arnold Bennetts need gibe no more at the scientific worker's literary ineptitude but take lessons from the book, how they may put real substance into their lines: it is seducing, though no seductions are pictured in the Saga; the young may read it with advantage, not merely with safety.

Yet when it is read—when the whole of the literature relating to the man, including his own works, is studied—we remain unable to account for the miracle he himself was. Seemingly, a magnetic personality was beaten into him by his father's hammerings. Maybe, he had his being in the unit charge of electricity which he was the first to divine: nearer we can scarcely get. In the East, he would long since have passed into tradition as a god. In his own country his name has yet to figure in the history books. Definitely a prototype, to be idealised as the truly scientific, all but faultless experimentalist and natural philosopher, the early stages of his mental development remain unfathomable. He was not a bookbinder's apprentice for nothing. He early became a reader of informative books; his style was formed, the habit of thinking for himself and his experimental outlook established, prior to his coming under Davy's inspiration—for Davy also was an inspired worker. Under and from him, he must have learnt much: it is strange that we know nothing of their intercourse. A man who could do what Davy did at so early a period, while on travel, with the simplest appliances, probably in his bedroom—who could work out the chemistry of iodine and establish diamond as carbon while visiting a foreign Court—must have had a magnetic personality and influence. The lines of force already ruled in Faraday's character must have been wondrously cut through and drawn out by such example. Still, in those years, he was but finding himself and overcoming his innate humility; he developed late, we know. This perhaps is why he passed no remark upon his master's work. On the other hand, we should be mindful of the advantage he enjoyed—one that none of us can enjoy to-day—in having an all but virgin field. Not because this gave boundless opportunity for discovery but because he was able to work without prejudice. Can a mind possibly grow up to-day so clean as Faraday's was? I doubt it. The student to-day rides in upon the last wave of fashion: so narrow is our human intelligence that he cannot thereafter rid himself of first impressions. We have only to think of the way in which the fear of the devil has been put into man's mind by priesthoods. The teachers of natural science are but a priesthood to-day, too often teaching faiths in misinterpretation of facts. Faraday was all but free from such priestly influence. We have yet to appreciate the perils of positive education dominated by examinations.

Faraday himself preached the most perfect sermon that has ever been preached, before Prince Albert, the Prince Consort, in 1854. Let us hope that this will be put into the hands of, at least, every visitor to the exhibition that will be held in September next at the Albert Hall. He laid down clear rules for mental education. The doctrine set out by Herbert Spencer, Huxley and others is already far better stated in this lecture—better because Faraday was both experimentalist and seer whilst they were doctrinaire teachers, Spencer especially.

In only one particular was Faraday subject to the restrictive influence of education and convention—that of religion. He was a strict Glasite (a Sandemanian). He kept his Sunday mind rigidly apart from his week-day mind, a fact sufficiently remarkable to deserve close psychological study. Since his day, not a few scientific workers of distinction have maintained a like attitude. Within us is an inherited power which not only limits our freedom of thought but also tends to direct us. Three words, said Faraday, express the great deficiency in the exercise of the mental powers: *deficiency of judgment*. The inability remains with us to day. It seems improbable that more than the few will ever learn to form *proportionate judgments*. Some of us have hoped that the faculty would be the outcome of early training in understanding and the use of knowledge: that it has not been so hitherto, let us hope, is because we have not yet learnt sufficiently to appreciate the force of Faraday's teaching and example as to apply it properly.

That Faraday was free from bias and prejudice in his experimental work is clear from his attitude towards spiritualism. He made table-turning the subject of close rational study and inquiry—with negative results. The conclusion of his letter on the subject is striking:

"I think the system of education that could leave the mental condition of the public body in the state in which this subject has found it, must have been greatly deficient in some very important principle."

We do not seem to have advanced very far in

the interval of nearly eighty years, notwithstanding all our education.

Faraday is remarkable in comparison with Ruskin, a man of eminently artistic temperament, yet highly scientific in his manner of work, a more than competent geologist Owing to his mother's commanding influence, Ruskin was a militant churchman It is clear that, as he grew older, he modified his views in no slight degree in late life, he even confessed that, were he to begin again, he might have shed his orthodoxy—it was only too late to begin Faraday and Ruskin moved in worlds apart—yet they had much in common To them we may add a third great influence in Victorian days—Carlyle. It may well be that such men are no longer possible—that the influence of 'combines' and of so-called 'rationalisation' in industry is to crush out the element of individuality to eliminate the element upon which the moral stability of the world specially depends Science to day is not cultivated to moral purpose so much as to gain some private end an we be not careful, future generations may have to record that, like the dog in the poem, it 'went mad and bit the man'

To be orthodox, let me say the book has a perfect index and wonderful pictures—the Royal Institution looks a mile long, as it ought to be !

HENRY E ARMSTRONG

Systematic Zoology.

Handbuch der Zoologie eine Naturgeschichte der Stämme des Tierreiches Gegründet von Prof Dr Willy Kukenthal Herausgegeben von Dr Thilo Krumbach Band 2 *Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Pria pulida* (1) Lieferung 6 (Teil 4 und Teil 5) Pp 147-242 + 64 17 gold marks (2) Lieferung 7, Teil 2 Pp 129-256 14 gold marks (3) Lieferung 8, Teil 4 Pp 243-402 18 gold marks (4) Lieferung 9, Teil 1 Pp 113-192 10 gold marks (5) Lieferung 10, Teil 4 Pp 403 482 10 gold marks (6) Band 4 *Progoneata, Chilopoda, Insecta* Lieferung 8 Pp 801-892 12 gold marks (7) Band 7 *Sauropsida, Allgemeines, Reptilia, Aves* Halfte 2, Lieferung 5 Pp 433-544 12 gold marks (Berlin und Leipzig Walter de Gruyter und Co, 1929)

SINCE our last notice of this valuable work, seven new parts have been issued The editor and the publishers are to be commended for their sustained zeal and for the manner in which text and illustrations are being produced. The parts before us are planned on the same lines as their predecessors, already noticed in these columns

(1) In this part three small but interesting groups of animals are considered Dr Remane, who has in recent years contributed a good deal to our knowledge of the Gastrotricha, is responsible for the account of this group and of the Kinorhyncha, and Prof Cori for that of the Kamptozoa (that is, the Polyzoa Entoprocta) All three chapters are noteworthy for the excellence of both text and figures, and they fully supply the needs of the advanced student Prof Cori has worked over the anatomy and histology of *Pedicellina* and has prepared more than forty original drawings, chiefly of this genus *Arthropodaria benedeni* occurs, as is stated, at Ostend, Prof Cori has omitted the record of this species from Hull, and of *Barentsia gracilis* from the Isle of Man

(2) Prof Fuhrmann, the author of the chapters on Trematoda, has written this account of the class Cestoidea, which includes the subclasses Cestodaria (with two orders Amphilinidea and Gyrocotylidea) and Cestoda In discussing the morphology of Gyrocotyle and its relative *Gyrocotyloides* (a new genus) the author advances good reasons for regarding the funnel as anterior Following the account of the two small but important orders is a useful summary, in about twenty pages, of the principal features of structure and of life history of the Cestoda, the orders of which are then described in turn, beginning with the Tetraphyllidea (40 pages), the Diphyllidea (6 pages), and the Tetrarhynchidea (unfinished) The wealth of well drawn new figures is a feature of this part

(3) Prof Max Rauther has produced in 150 pages a useful account of the Nematoda—their structure, development, physiology, ecology, and systematics He must have been faced often with the difficult problem of what should be included and what omitted, and on the whole he has chosen judiciously Many readers would have welcomed a somewhat fuller treatment of free living Nematodes, for the emphasis in this work is on the parasitic forms Instead of the brief reference to diminution of chromatin we should have preferred a short illustrated account of the chromosomes of *Ascaris* and their history during the early cleavages of the egg, to bring out, as this case does so well, the principle of the germ-track

(4) The major portion of this part is devoted to a description by Prof Bresslau of the reproductive apparatus and development of *Turbellaria* It

includes an admirable account, with numerous schematic and other illustrations, of the different types of reproductive apparatus, and a description of the development of entolecithal and of ectolecithal eggs The remainder of the part deals with the physiology of movement and of the eyes This memoir on the Turbellaria promises to be the best available general account of the class

(5) Prof Rauther is also the author of the chapters on the Nematomorpha (46 pages) and the Acanthocephala (34 pages) For both groups the accounts of the different systems of organs, the life history, and systematics are well done and are illustrated by 96 figures, many of them original or from recent memoirs

The second volume of the "Handbuch", in which these five parts are included, reaches a high standard and we look forward to the appearance of the remaining parts of this volume, especially those on the Polychæta, Hirudinea, and Gephyrea

(6) Dr Handlirsch continues his account of the Insecta The present chapters deal successively with seven orders, including the Mantodea, Blattariæ, Isoptera (with some good illustrations of the nests of termites), Mallophaga, and Siphunculata The external morphology is adequately considered, but the internal organs of some of the orders deserved fuller treatment, and the systematics of both Mallophaga and Siphunculata could with advantage have been rather more extended We should have desired to see included some references to the histology of the organs and tissues and to the occurrence of symbionts there is no reference to these, and the mere remark that there are gut parasites in termites gives no suggestion of the very interesting relationships which exist between the termites and their intestinal protozoa

(7) Dr Stresemann maintains his high standard in the further description of the biology and structure of birds The major portion of this part is concerned with the food of birds and the associated structural modifications of beak, tongue, and foot the relations of birds to flowers, the storage of food, for example, by the Californian woodpecker, the processes of digestion, the biochemistry of eggs and of metabolism in the embryo, and the periodic changes in the reserve of fat The later part of the chapter deals with the anatomy and physiology of movement of the vertebral column, of the legs, and of the sleeping posture (unfinished) The author has drawn his material from a great variety of sources and has treated the subjects considered in a thorough and interesting manner

Bartholomew Sikes's System of Alcoholometry

Alcoholometry an Account of the British Method of Alcoholic Strength Determination, with an Historical Introduction written by the Author in collaboration with George H Gabb By Francis G H. Tate Pp xviii + 93 + 12 plates (London H M Stationery Office, 1930) 5s net

BARTHOLOMEW SIKES devised a system of alcoholometry which was legalised in Great Britain in 1816 for ascertaining the strength of spirits for revenue purposes and has remained in official use ever since He designed a metal hydrometer and compiled tables for use in conjunction with it, which, together, provide a simple means of determining the strength of mixtures of alcohol and water All that has to be done is to float the hydrometer in the sample of which the strength is required, observe the hydrometer reading, take the temperature of the sample and then consult the tables, where, under the temperature and against the hydrometer reading, is found the strength of the spirit Such a simple and rapid method was not devised in a moment Indeed, the Excise Department was established in 1643, nearly two hundred years before the adoption of Sikes's system, and from its inception one of its duties was the collection of taxes levied on spirits

The early part of Mr Tate's book gives an account of the development of alcoholometry in Great Britain prior to the adoption of Sikes's system In brief, the important points are the origin of the term 'proof spirit' in connexion with the early 'gunpowder test', the re invention of the hydrometer by Boyle in 1675, which led to the development of the hydrometer for spirit assaying, the legalisation of the use of Clarke's hydrometer in 1787, and the classical work of Gilpin and Blagden (*Phil Trans Roy Soc*, 1790, 1792, and 1794) on the density of mixtures of alcohol and water Here the author is traversing ground which has been covered by other writers, but so recently as 1898 Scarisbrick, an official of the Inland Revenue, wrote in his "Spirit Assaying" "Sikes does not seem to have left a scrap of information as to the principles underlying his system"' Mr Tate, however, has had access to twenty-eight manuscript note books left by Sikes, and so is able to contribute new material to the study of Sikes's system

Hitherto the only information available has been that contained in the Act of 1816 and the tables legalised by the Act These, however, contain no explanation of the basis of construction either of the

hydrometer or the tables, and a number of questions relating to these matters have been the subject of controversy and conjecture

It has been suggested that Sikes ignored the fundamental work of Gilpin, adopted a hydrometer previously designed by Boriés, prepared a skeleton table by reading this hydrometer at various temperatures in spirits made up to known strengths, and completed the tables by interpolation Mr Tate is able to show that Sikes gave considerable thought to the design of his hydrometer and made the fullest use of the accurate data of Gilpin in compiling his tables He is also able to show how the rather unusual temperature 51° F came to be employed in the definition of proof-spirit

The strength of a spirit expressed as the percentage of alcohol by volume in the spirit can only be valid for one particular temperature Proof-strength is merely a roundabout method of expressing percentage composition by volume—at 50° F 100 gallons of a spirit *n* per cent over proof contain the same volume of alcohol as $(100+n)$ gallons of proof-spirit, also at 50° F —and so proof strengths must also be defined at one particular temperature The temperature adopted by Sikes for his proof strengths was unknown, and attempts to determine it from such evidence as is available in the Act and tables have led to values ranging from 51° F to 62° F Mr Tate is able to produce evidence from Sikes's note books showing that the temperature which he actually used was 50° F

It is a well known anomaly of Sikes's system that the duty assessed on a given weight of spirit varies with the temperature at which the assessment is made, the duty charged being greater when the spirit is assayed at a high temperature that when it is assayed at a lower temperature Sikes's note books include tables of corrections which would eliminate this anomaly, but they have never been adopted for official use

The new information regarding Sikes's system which Mr Tate has made available will be of interest to many readers His book also gives an account of the preparation of revised Sikes's tables by Sir Edward Thorpe, which received Parliamentary sanction in 1915, the recent extension of the range of the hydrometer and tables legalised in 1930, and the three last chapters deal with the standardisation of hydrometers, methods of allowing for 'obscuration', and the use of the refractometer respectively A useful bibliography is given at the end of the book

One important question is not discussed in the book Metal hydrometers have very obvious disadvantages as compared with glass hydrometers, and even so long ago as 1792 Blagden advised the authorities that metal hydrometers were unsatisfactory Glass hydrometers have largely replaced metal ones for assessing the duty on spirits in India, and in industry generally, glass hydrometers are used almost to the exclusion of metal ones The relative merits of glass and metal hydrometers, however, are not discussed in the book

Plant-Dispersal

The Dispersal of Plants throughout the World By Henry N Ridley Pp xx + 744 + 22 plates (Ashford, Kent L Reeve and Co, Ltd, 1930) 63*s* net

An authoritative and comprehensive work on plant dispersal—mainly, that is, the means by which fruits and seeds of flowering plants and spores of ferns, mosses, and other cryptogams are dispersed from the parent plant—has long been a desideratum Such a work is now to hand, and we congratulate Mr Ridley on the completion of his book, which embodies the results of his own observations over many years and of a digest of the very considerable and widely scattered literature of the subject

Mr Ridley is a keen naturalist and his first hand knowledge of the vegetation of Malaya, his home for twenty years, and his visits to other parts of the world, have allowed him a wide view of his subject. In his introduction, he refers to the absence of an adequate work on plant dispersal, the more remarkable in view of its important bearing on the distribution of plants throughout the world, and as a factor in the evolution of species and genera of even more importance than modifications for insect or wind-pollination—a subject on which there are fairly complete treatises Changes in climate and environment have supplied special opportunities for the effective operation of means of dispersal, and competition between individuals of a species or between different species has also been an important factor Modifications for dispersal are of a secondary nature, in cases where there exists a tolerably complete series of genera or species the author can discover " no sudden change in Nature giving rise to modifications of fruit or seed for the purpose of dissemination The evolution of a winged or adhesive fruit or seed seems to have been gradual, and to have been effected by a reduction or accrescence of certain parts, which had a primary use not connected with dispersal "

The hairs on the ovary, a protection from rain,

may develop in the fruit into wool for wind dispersal or into spines or hooks for attachment to passing animals, and sepals may persist and enlarge to form wings or floating plates for the ripe fruit A minute and apparently trivial alteration is frequently critical for the distribution of the species The occasionally firmer texture of the funicle in seeds of *Laburnum* keeps them attached to the pod until that is blown away by the wind, thus ensuring a wider dispersal than the mere scattering of the seeds round the parent plant

The headings of the chapters are supplied by the various agents operating in dispersal—wind, water, animal, or a mechanism inherent in the plant itself Wind plays one of the most important parts, it scatters not only seeds or fruits provided with some special mechanism such as wings or plumes, but also very largely those of which the small size and lightness are the only aids to dispersal It is most effective in open country, across arms of the sea or tracts of desert In arctic regions, fruits and seeds may be blown across the ice or carried by drift ice to distant shores, "many of the arctic plants found on the summits of the mountains of temperate Europe, Asia, and America probably owed their position to wind blowing over the ice in the Glacial period" Few seeds compare in lightness with the quartz-grains which have been found 700 miles from land, but, as Wallace pointed out, their compression and irregularity of outline, offering a larger surface to the air, is a compensating factor, the absence, however, of certain widely distributed small-seeded plants from remote islands suggests that favourable conditions for their flight must be scarce

In the tropics, most of the epiphytes on the trunks and boughs of forest-trees are wind borne, though in the formation of the flora of the pollard-willows of Great Britain birds play a conspicuous part in the carriage of berries and drupes The dust-seed of orchids is produced in enormous quantity, and the occurrence of species on remote islands indicates its efficacy for dispersal Plants with plumed fruits and seeds are scarce or wanting in dense forests and on oceanic islands These are practically unable to cross large tracts of water, but fall into it after a few miles of flight Such plants are continental, mostly herbaceous, and so, quickly fruiting, can rapidly cross mountains and open country, if their fruits or seeds fall, the following blasts pick them up and carry them on Adaptations for wind dispersal are manifold and are provided by various parts of flower and fruit, an account of these occupies nearly one hundred pages of the book

The action of water in dispersal is perhaps even more important than that of wind, but the associated modifications are not so elaborate or striking. Sufficient buoyancy and a sufficiently long period of impermeability by water are almost the only requirements Both large and small seeds are frequently dispersed by rain-wash or sudden rushes of water Heavier seeds may sink and germinate at the bottom, rising to the surface as seedlings to be drifted away and stranded on a suitable bank Ice, stream, river, and flood are all effective agents in carrying fruits and seeds or large portions of a plant Mr Ridley gives a comprehensive list of river-dispersed species, with notes based on observations by himself and others Dispersal by sea is treated in an even more comprehensive manner

Exigencies of space forbid more than a passing reference to the chapters on dispersal by animals—mammals, birds, reptiles, fish, insects, and others—and the devices of the plant for effecting adhesion to the carrier, or by human agency, or some mechanism in the mature fruit from which the seeds are shot explosively A chapter on island floras indicates briefly how the various agents have operated in stocking a number of oceanic islands

To use a hackneyed phrase, the book is a mine of information, and is, moreover, eminently readable There is a remarkable absence of technical terms, though it is in no sense a 'popular' production The illustrations, by Miss M B Moss and the author, are helpful to the understanding of the many devices for transport of fruit or seed A B R

Our Bookshelf

(1) *The Fields and Methods of Knowledge a Text book in Orientation and Logic* By Prof Raymond F Piper and Dr Paul W Ward Pp xxv + 398 + xl (New York and London Alfred A Knopf, Inc, 1929) 16s

(2) *Rational Induction an Analysis of the Method of Science and Philosophy* By Dr Homer H Dubs Pp xv + 510 (Chicago University of Chicago Press, London Cambridge University Press, 1930) 21s net

(1) The two books under review have several things in common, although their scope is different The dominating purpose of Profs Piper and Ward is educational, while Dr Dubs investigates the traditional methods of proof The endeavour of Profs Piper and Ward to lead their readers to a better acquaintance with the physical universe, society and man, is not an innovation in teaching But in view of the extraordinary growth of human knowledge, it seems useful if not necessary that 'freshmen' be given a comprehensive panorama of the fields and methods of knowledge, with the view of helping their orientation and to enable

them to think for themselves In this, Profs Piper and Ward have succeeded, and their practical classification of the sciences could be read with profit even by specialists on one subject or the other

It is difficult to dispute on any point of the book if one takes into account its purpose But one cannot fail from noting the pragmatic character of its exposition For example, the importance of the calculus is denoted with reference to its applications to reality Again, in the exposition of logic, much prominence is given to induction, verification, and discovery, while formal logic is summarily treated The bibliographies at the end of each chapter, the appendix on questions and exercises, and a very good index are features which enhance the practical value of this work

(2) Dr Dubs has written a comprehensive book on inductive logic, and one which has the distinction of being accurate and clear But it is difficult to note anything in it of the importance announced by the author in his preface His main thesis is that "induction always concerns itself with the establishment of the correctness of a hypothesis or assumption The attempt to establish this hypothesis may be by one of three ways empirical induction, immediate description, or rational induction, which is the most general of them all Its very simplicity, however, has often led to its being misunderstood by those who have used it, especially by logicians, who have too often tried to assimilate it to the better recognised deductive procedure" (pp 126 127) So the author endeavours to re-state the case for rational induction, but in doing so, he hits upon scarcely anything new in the field of inductive logic T G

Joseph Fraunhofers Leben, Leistungen und Wirksamkeit Nach Quellen geschildert von Prof Moritz v Rohr (*Grosse Manner Studien zur Biologie des Genies*, herausgegeben von Wilhelm Ostwald, Band 10) Pp xx + 233 (Leipzig Akademische Verlagsgesellschaft m b H, 1929) 15 gold marks

IN this sympathetic and concise biography, Prof von Rohr has rendered yet another service to science The achievements of Joseph Fraunhofer, who was the founder of the modern technical optical industry in Germany, were too little known even in his own country

The book paints a grey picture of the optical industry at the opening of the nineteenth century, with its preoccupation in the mass production of cheap spectacle lenses and its lack of attention to more complex instruments It is suggested that English opticians owed much of their pre-eminence at that time to the demands of seamen for telescopes and the like

Whence springs genius? How could this lad with his desultory and indifferent schooling train himself to become a leader not only in technical practice, but also in those fundamental steps which mark the emergence from crudeness and haze to precision and clarity in the understanding of the underlying principles of technical optics? All the world knows of the Fraunhofer lines and their applications to exact refractometry, but how many realise the painstaking efforts at refractometry with the aid of a monochromator, the ambitious attempt to produce non-spherical surfaces of optical accuracy?

Fraunhofer belongs not to Germany alone but to the world To read this little book is to gain a clearer perspective in one's view of present-day problems, and encouragement in the patient efforts which they require L C M

Handbuch der anorganischen Chemie Herausgegeben von Prof Dr R Abegg, Dr Fr Auerbach und Prof Dr I Koppel In 4 Bänden Band 4, Abteilung 3 *Die Elemente der achten Gruppe des periodischen Systems* Teil 2 *Eisen und seine Verbindungen* B Lieferung 1 Pp Bxvi + B463 (Leipzig S Hirzel, 1930) 45 gold marks

THE high standard of all the volumes of Abegg's "Handbuch" is too well known to require comment, and it is only necessary to announce that a further volume has appeared in which the description of the elements is carried into the eighth group The rapid progress towards completion under the editorship of Dr Koppel is to be especially praised, and the way in which he has maintained the character of the work deserves the highest commendation Unlike some other comprehensive works on inorganic chemistry, 'Abegg' has always been characterised by a maturity of exposition and a critical treatment of the material which shows clearly that the contributors have not been content merely in amassing abstracts The present volume, which deals with compounds of iron, covers the field in a way which leaves nothing to be desired It will be invaluable to all chemists As in previous volumes, emphasis is laid on the physico-chemical aspects of the substances, but not to the neglect of descriptive chemistry The complex iron cyanides and colloid systems are to be dealt with in another volume

An Introduction to Regional Surveying By C C Fagg and G E Hutchings Pp xi + 150 (Cambridge At the University Press, 1930) *7s 6d* net

REGIONAL survey, as an exercise in concrete geographical study, was introduced into university education in Great Britain by the late Prof A J Herbertson under the inspiration of Prof P Geddes The methods since then have been utilised in most of the schools of geography in Great Britain, and a great deal of work has been accomplished, though relatively little has been published, largely for lack of means The authors of this small volume are enthusiasts and have themselves done good work in regional survey They set out here to explain some of the methods of field work and mapping Their aim is practical guidance, and even if they explain a good deal that will be obvious to any student of geography, they have written a useful handbook for which there is a real need There are several sketch maps and diagrams

Letters to the Editor.

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Atmospheric Pressure and the State of the Earth's Magnetism

WHILE examining data for atmospheric pressure and terrestrial magnetism at various observatories of the Meteorological Office to discover possible relationships, and after meeting with no clear cut success so long as attention was confined to daily mean values of pressure, I have now obtained results pointing to a hitherto unsuspected relation between the type of the diurnal variation of pressure and the general state of magnetic conditions, as regards disturbance and quiet, over the earth As the best available index of the degree of magnetic disturbance

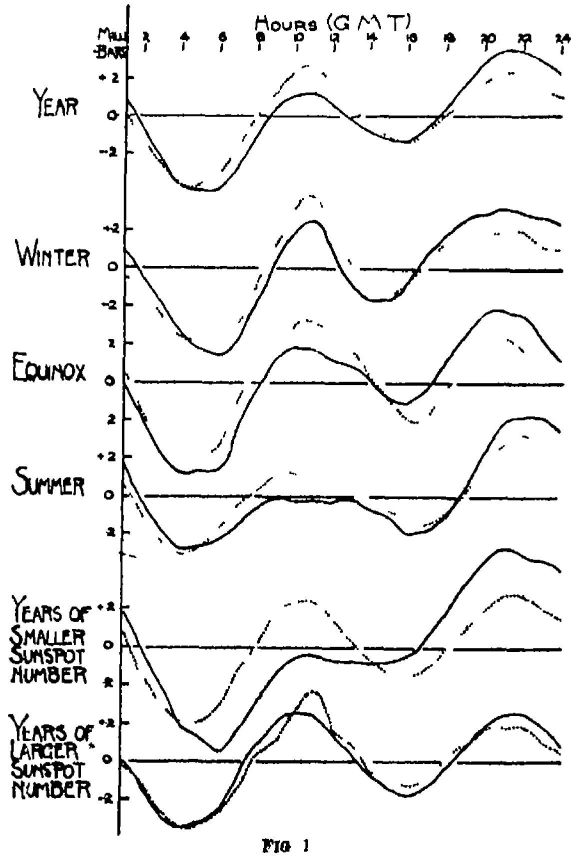


FIG 1

on each Greenwich day, the international magnetic character figure was used, the pressure data were those for Aberdeen Observatory as printed in the Observatories' Year Books of the Meteorological Office, Air Ministry Mean diurnal inequalities of pressure corrected for non-periodic change were computed for the two sets of days, magnetically quiet and magnetically disturbed, on the basis of the five days of each type per month selected at De Bilt over the seven years 1922–28

By grouping the inequalities according to the season of the year (defining winter as the four months November–February, summer the months May–August, and the remaining four months forming equinox), diurnal variations of pressure representative of the three seasons were constructed A further rearrangement of the data gave inequalities illustrating the pressure variations on the two types of days in years of low and high solar activity The mean sunspot number for the group of years 1922–24 is 12 2, for 1925–28 the mean is 63 5

The results are shown in the six pairs of curves on Fig 1 The dotted curve in each pair represents the diurnal variation of pressure on magnetically quiet days and the full curve on magnetically disturbed days The difference in form clearly shows the change in the pressure variation from one type of magnetic days to the other

From these it is clear that in all but the last pair the predominant features of the change are the reduced development of the forenoon maximum and enhancement of the evening maximum on disturbed as compared with quiet days That the effect is consistently present in each of the pairs of curves for the separate seasons as well as for the year as a whole is strong evidence of its reality The last two pairs of curves illustrating the change of form of the variation in years of relatively low and of relatively high solar activity clearly indicate that, while the change is very marked in feebly active years, it may be masked or even partly reversed in years of frequent and large sunspots

When the mean inequalities are analysed harmonically, it becomes obvious that change of form of the variation is confined almost entirely to the 24 hour wave, the amplitude and phase are both affected In each pair of magnetically quiet and disturbed day pressure variations, except that for the group of years 1925–28, the amplitude of the first harmonic on disturbed days exceeds that for quiet days The ratio of the amplitudes increases from 1 4 for the winter months to 1 7 for equinox and 2 2 in summer, in the group of years of low sunspot development it is 3 3 In all the groupings of the data there is a retardation of the 24 hour wave in passing from quiet to disturbed days, the retardation is a little more than two hours in all groups except that representing high solar activity, when it is about half an hour

Against these changes in the whole day wave the constancy of the 12 hour component is striking The ratio of the amplitudes for the two types of days remains steadily about unity in all groups and the changes in phase angle are not significant

J M STAGG

Lerwick Observatory, Shetland

The Karoonda (S A) Meteorite of Nov 25, 1930

AT 10 53 P M on the evening of Nov 25 an extremely brilliant fire ball was seen by many observers in South Australia It was observed at Port Lincoln on the west coast, Wirrappa (94 miles north west of Port Augusta), Mount Gambier in the south east of South Australia, Murrayville in Victoria, and Broken Hill in New South Wales, the radius of observation being thus well over 250 miles

When first seen, the meteorite compared in brightness with a star of first or second magnitude, but rapidly (in a few seconds) increased to a brilliancy which gave an illumination comparable to that of daylight, even in Adelaide An amusing feature of many reports is the illusion of close proximity due to this brightness It was described by many observers as an immense ball of bluish white colour, equal in diameter to the full moon, and having a luminous tail several degrees in length As it approached the earth showers of sparks issued from the main body

Observers within a few miles of it heard a noise which is variously compared to the loud rumble of an earthquake, to the roar of a passing train, or to "the banging-together of sheets of galvanised iron" Messrs. Honeyman and Millard, of Karoonda, who were nearer the locality of the fall than any other observers (2½ miles distant), give the following account " the disappearance of the meteorite was followed by a loud detonation as though a very heavy charge of explosive had been let off underground This caused a distinct vibration of buildings near by This sound was followed, at an interval of about three seconds, by a loud crackling and rending sound from the sky in the direction in which the meteorite was last seen, then by a low rumbling of thunder which gradually died away in the distance"

The meteorite appears to have descended at a steep angle of about 70° with the horizontal When first seen it had an altitude of 150 miles or more, and the duration of its fall was approximately six seconds It travelled in an east south-east direction

A search party from the University of Adelaide and Adelaide Observatory proceeded to Karoonda on Dec 6 Two days were spent in making inquiries from local eye witnesses of the fall These enabled the locality to be determined within a radius of one or two miles, and on the third day the meteorite was found lying in a sandy fallowed wheat field, 2½ miles east of the township of Karoonda It had made a crater like hole in the sand eighteen inches in diameter and about the same depth, with a surrounding ridge of sand three feet six inches across

The meteoritic stone had shattered on striking the earth, and numerous fragments were scattered over a radius of four or five feet The bulk of its mass, however, was within the crater, the largest fragments being on the east side and pointing nearly vertically down In addition to pieces varying from an ounce or two to seven pounds in weight, there were very numerous smaller fragments and much finely pulverised material mixed with sand The whole was collected, and the meteoritic material separated from the sand in a magnetic separator The total weight of the meteorite was thus ascertained to have been 92 lb On some of the larger fragments a surface layer about one millimetre thick had obviously undergone recent fusion, and both this and other parts of the surface showed the customary 'thumb marks' and lines of flow

The meteorite is of a type unfamiliar to any persons who have yet seen it, and possibly unrepresented in Australian collections It is certainly an 'aerolite' or stony meteorite, and probably of the class termed "Chondrites" by Prior (Guide to the Collection of Meteorites—British Museum Handbook) and the sub class or group "Enstatite—Chondrites"

The material is uniformly of a dark grey, approaching a black colour, with numerous spherical inclusions (chondrules) and specks of metallic lustre, possibly troilite It is quite friable, has a specific gravity of 2·44 and a distinct 'earthy' odour A chemical analysis is in progress

KERR GRANT
Adelaide G F DODWELL
(Government Astronomer)

Rational Logarithms

I HAVE recently been considering how best the theory of logarithms could be presented to a beginner without such a paralysing opening as used to be the practice (see Todhunter) I do not know what is done now But the result of this consideration has been the development of a complete exposition of the whole fundamental principle of the logarithm without any of the mathematical treatment which, so far as I know, is universally employed The idea, of course, is that this should be an introduction to the usual mathematical treatment, not a substitute for it.

Any discussion with beginners is nothing if not concrete, so that actual figures must be obtained I have found that this fundamental, basic, or 'low down' treatment of the subject leads directly to a very convenient approximate expression for the logarithm to base e of a number As is the case with the usual expansions, the expression becomes peculiarly simplified when it is used to find $\log(n+1)/n$ or $\log(n+1) - \log n$, and in order to keep this note within reasonable limits, I give the expression for this only This is $\log_e(n+1) - \log_e n = \dfrac{12n(n+1)+1}{6n(n+1)(2n+1)}$

This gives the logarithm with great facility and with very considerable accuracy

With $n = 10$ the error is 0·0⁷65506
$n = 100$,, 0·0¹²81284
$n = 1000$,, 0·0¹⁷8311

In obtaining the fractional expression, two very small errors are intentionally made for the sake of simplicity The first is almost exactly eliminated by subtracting $\dfrac{1}{12(n+1)^2(2n+1)^3}$, but this merely reduces the error by over correction to one eighth of what it was with $n = 9$, increasing to one quarter with $n = 1000$

The residual error is due to the second cause and as yet I have not been able to get an expression to meet it That for the first correction, however, is obtained by interesting and instructive means, not quite so easy as those employed in obtaining the original fraction

I have never seen this way of dealing with logarithms described I should have expected to find it in Hutton's introduction to his famous tables of 1794, where he discusses every method known at that date At the same time, it is difficult to imagine that so elementary a process, suitable almost for a kindergarten, is not known, or if it is, why it is not used

C V BOYS

Denaturation of Wool by Urea

IN a letter to NATURE of Nov 1, p 685, I stated that saturated aqueous solutions of urea unmasked a sulphide in sheep's wool and also extracted a sulphide from the wool These two statements were based on the observation that addition of a tenth volume of 20 per cent sodium nitroprusside solution, to suspensions of wool in such urea solutions, ten minutes after addition of a similar proportion of 10 per cent potassium cyanide solution (to reduce any –SS– to thiol groups), always led to the development, both in the wool and in the liquid, of a strong pink or magenta colour precisely like that of Arnold's nitroprusside reaction for organic thiol compounds, although in control tests wool not treated with urea developed only a feeble pink, and urea solutions which had not been in contact with wool developed none at all

I write now to say that the conclusion that the urea solution had extracted a sulphide from the wool was erroneous, for subsequent work has shown that the apparently typical thiol reaction obtained in the extracts was due entirely to a hitherto unknown, and at first very elusive, reaction between urea and some derivative of sodium nitroprusside, previously formed in its solution as a result of an obscure change which may for temporary convenience be referred to as 'ripening' If the nitroprusside solution is ripe enough, this reaction with urea will become obvious

within a few minutes, though it may take a long time to attain its maximum With unripe nitroprusside solution, it may require any time up to two hours to begin, or it may fail altogether It occurs only if the test mixture is alkaline but not too strongly so, and only if ammonia is absent It is quicker and more intense the stronger the urea solution, but is recognisable in 2 per cent solution It can be distinguished from a true thiol reaction by the fact that on addition of ammonia the colour soon fades to yellow In the light of these observations, it is now evident that in my former experiments the nitroprusside solutions used when testing the extracts of wool must have been fully ripe, and that used in testing the control urea solutions must have been much less so The wool itself would react equally strongly with either solution

I have made only incidental observations on the process of ripening An approximately neutral 20 per cent nitroprusside solution is sometimes adequately ripe after it has stood twenty four hours, but the time required varies greatly in different glass vessels, and the solution usually improves up to at least a fortnight No deposit is formed, and the only obvious change is a slight yellowing Ripening is much quicker in the presence of 1 per cent of sodium bi carbonate, but if such a solution is saturated with urea it soon undergoes a change, as a result of which it will turn blue or green when acidified with hydro chloric acid containing ferric chloride, although the ripe solution does not give this reaction by itself

While still exploring the conditions necessary for this 'pseudo thiol' reaction, and contemplating the possibility that it might be responsible also for the apparent thiol reaction given by the urea treated wool, I received from Dr Rimington, of the Woollen Industries Research Association at Leeds, a letter saying that wool which he had treated for twenty four hours with saturated urea solution and then washed in water refused to give a thiol reaction His procedure had been to suspend the washed urea treated wool in saturated ammonium sulphate solution, then reduce it by adding sodium cyanide up to 0 55 per cent, and after ten minutes add fresh nitroprusside solution and ammonia In my own procedure the wool had always been reduced by 1 per cent potassium cyanide solu tion while still in the urea solution, and had hence been exposed during ten minutes to a markedly alkaline urea solution Also, the Arnold test had always been applied in the presence of urea and with out addition of any ammonium compound, conditions under which a pseudo thiol reaction might conceivably occur

I have accordingly made a further set of experi ments, in which comparisons were made between the intensities of the Arnold reaction given by wool which had been treated with saturated urea solutions alkalised to different extents by addition of suitable salts, and in which any pseudo thiol reaction was pre cluded by applying the Arnold test only after the wool had been washed during twenty four hours with large volumes of water, and then reduced in 1 per cent potassium cyanide solution for ten minutes, after which a little ammonium sulphate was added to the cyanide suspension, followed by freshly made nitroprusside solution The results show that any apparent thiol reaction given by the wool thus tested is a genuine one, and also that more sulphide is unmasked in ten minutes by urea solution containing 1 per cent potassium cyanide solution, or half per cent sodium carbonate, than in twenty four hours by 1 per cent potassium cyanide solution or in ten minutes by half per cent sodium carbonate, or in twenty-four hours by approximately neutral urea solution The experiments do not show, however, whether neutral urea solutions unmask very little sulphide or none at all, for I have been unable to find wool which does not give at least a slight Arnold reaction after reduction in 1 per cent potassium cyanide solution and it is impossible to attach significance to slight contrasts in the intensities of the colours, since these often fade rapidly when the wool is removed from the test-liquids Comparing wools which have been exposed during ten minutes to a temperature of 100°, one in water, the other in saturated urea solution, there is, however, a great contrast, only the latter becomes intensely pink As the liquids become feebly alkaline during the heating, this experiment does not show the effect of neutral urea solution My former bald statement that saturated urea solutions unmask a sulphide in wool should accordingly be qualified by addition of the words "at least when they have more than a certain alkalinity"

In the case of egg albumin treated with urea, where Hatton and I took as a measure of the amount denatured the percentage of protein rendered insoluble in 27 per cent ammonium sulphate solution, we found that when the cH of the saturated urea solution was approximately that at which egg-albumin is isoelectric, the rate of denaturation was a minimum and very slow, and that the more remote the cH was from this, the quicker was the rate, especially on the alkaline side none of the alkalinities or acidities concerned was so great as to bring about more than negligible denaturation in the absence of urea I have not ascertained whether any similar relation would hold good for wool when the unmasking of sulphide is taken as a measure of denaturation, but the results referred to earlier strongly suggest that it would at least be true for such variations in cH as lie on the alkaline side of the hydrion concentrations common in distilled water W RAMSDEN

Department of Biochemistry,
University of Liverpool,
Feb 13

Agricultural Field Experiments

MR HOWARD's letter in NATURE of Jan 31 (p 166) gives interesting confirmation of the reviewer's opinion in NATURE of Nov 29, p 843, that depth of sowing influences the yield of wheat, yet I venture to suggest that such an extreme case as he quotes scarcely bears upon the point at issue When seeds do not germinate, it is equivalent to a light seeding rate, which, as I pointed out, makes wonderfully little effect on the yield Whether such differences as one may expect to occur between the depths of coulters in the same drill make any appreciable effect on the yields of the different rows is still, I think, an open question, and I suggest that the differences which the reviewer has observed between the yields of his rows may have been due to their being unevenly spaced The yield which is comparatively unaffected by seeding rate, is that per areal and not that per linear unit The reviewer quotes "an apparently uniform field" at Aarslev as upsetting my view that for practical purposes randomness can be obtained from the half-drill strip "provided care is taken to drill across ploughman's 'lands'", if they exist, yet Dr Sanders in his account of that experiment makes no mention of an "apparently uniform field" (*Journal Agricultural Science*, **20**, p 65), but writes, "This oscillation apparently arose as a legacy of the old practice of ploughing in high ridges", and so on

Even if the unsuitability of the field had been overlooked, the Aarslev plots were probably a good deal wider than drill width, and half-drill strips would have been extremely unlikely to coincide both in breadth and phase with the periodicity in question, while any

partial coincidence would have betrayed the existence of the snare.

Finally, there is a fallacy in Mr Howard's last sentence—"It is obvious in such questions that nothing can be gained by the application of formulæ and figures to the results obtained by poor agriculture" There is no question, of course, of connecting the half-drill strip method of experimenting with poor agriculture, its great merit lies in the fact that in its present form it is ordinary farming practice if, however, that practice were poor agriculture, it would be a mistake to carry out trials by methods conforming to better standards field trials must be capable of being considered a random sample of the practice, not of the theory, of agriculture

This may seem a hard saying, but an example will make my meaning clear After a long series of experiments the Irish Department of Agriculture decided to introduce Dr Hunter's Spratt Archer barley as being the best suited for the country This was almost everywhere a great and outstanding success, yet in one district, which shall be nameless, the farmers refused to grow it, alleging that their own native race of barley was superior to it After some time the Department, to demonstrate Spratt Archer's superiority, produced a single line culture of the native barley and tested it against the Spratt Archer in the district in question To their surprise, they found the farmers were perfectly right the native barley gave the higher yield At the same time the reason became plain the barley in question starts more quickly and is able to smother the weeds, which flourish in that not too well farmed land, Spratt-Archer, growing less strongly at first, is, however, the victim and not the conqueror of the weeds, and the original experiments, carried out on well farmed land, were definitely misleading when their conclusions were applied elsewhere

Taught by experience, the Department is now engaged in breeding a barley to meet these conditions, and this barley, when obtained, will rightly be tested by "results obtained by poor agriculture"

STUDENT

REFERRING to the effect of increased depth of sowing, "Student" writes "When seeds do not germinate, it is equivalent to a light seeding rate" This is true, but changes in depth of sowing give rise to changes not only in the percentage germination but also in the time of germination It is my experience that yield may be affected by both these factors.

My description of the field at Aarslev as "apparently uniform" would seem to be justified by Dr Sanders' statement that "This oscillation *apparently* arose as a legacy of the old practice of ploughing in high ridges" (italics mine)—appeal was made to the history of the field for an explanation of the curious periodicity

I am in complete agreement with the concluding part of "Student's" communication, summed up in his own phrase, "field trials must be capable of being considered a random sample of the practice, not of the theory, of agriculture" This is too often overlooked by those who use special machinery and methods for field experimental work

THE WRITER OF THE ARTICLE

Vacuum Spark Spectra to 40 A.: the Spectra of Be III, Be IV, B IV, B V, and C V.

THE series of hydrogen and helium-like spectra, which was previously traced [1] to Be IV, has now been completed with B IV, B V, and C V, and the limit of optical spectra brought down to 40 28 A

The vacuum spark was produced by a capacity of 0 3 μF charged to 60,000 volts Half an hour with about 30 sparks a minute was sufficient for an exposure The plates were taken with the same metal grating as was used before,[1] but now set up in a new spectrograph at a glancing angle of 5 4° Comparing the results with those from a glass grating [2] at 6°, there seems to be no reason to prefer this material to speculum metal in the shortest wave length region

Fig 1, *a*, shows the spectrum obtained with metallic

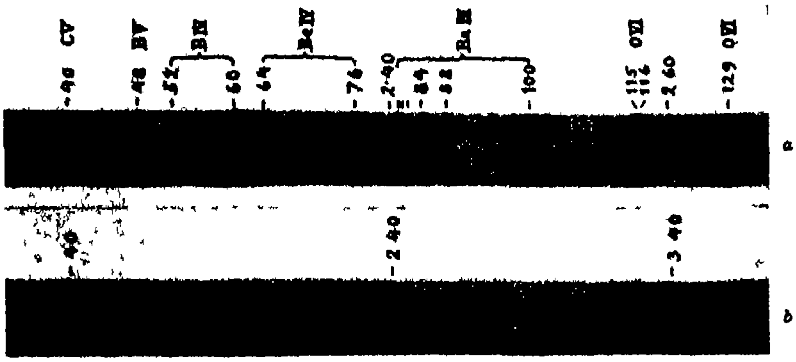


FIG 1

beryllium as the negative electrode against a tube of Acheson graphite filled with boron nitride A spark between pure graphite electrodes gave the spectrum of Fig 1, *b*, consisting of one single carbon line at 40 A in the first three orders

Of the series $1\,^2S - n\,^2P$ in the hydrogen like spectra, there appear two lines of Be IV and one of B V The wave lengths in the table were calculated with regard to the fine structure according to the formula given by Penney,[3] and used as standards

	Be IV		B V	
	ν	λ	ν	λ
$1\,^2S - 2\,^2P$	1,317,084	75 925	2,058,247	48 585
$1\,^2S - 3\,^2P$	1,560,962	64 063		

As shown in the second table, the helium-like series $1\,^1S - n\,^1P$ is considerably more strongly developed The relative intensities can be estimated from Fig 1, *a*

	Be III		B IV		C V	
	λ	ν	λ	ν	λ	ν
$1\,^1S - 2\,^1P$	100 26	997,500	60 31	1,658,100	40 28	2,482,600
$3\,^1P$	88 30	1,132,500	52 68	1,898,300		
$4\,^1P$	84 75	1,179,900				
$5\,^1P$	83 19	1 202 100				
$6\,^1P$	82 37	1,214,000				

From the series of Be III the quantum defect for the ^1P terms is calculated as $n - n^* = -0\,013 \pm 0\,001$ A comparison with He I and Li II indicates the numerical value to be constant or slightly diminishing with increasing atomic number The simple assump-

tion of the same quantum defect for Be III, B IV, and C V gives the following term values

	B IV	C V
$n - n^*$	$-0\,013 \pm 0\,002$	$-0\,013 \pm 0\,003$
$2\,^1P$	$433\,300 \pm 900$ cm^{-1}	$677{,}000 \pm 2000$ cm^{-1}
$3\,^1P$	$193\,400 \pm 300$,,	
$1\,^1S$	$2091\,500 \pm 1400$,,	$3{,}159{,}600 \pm 3300$,,

The ionising potentials $1\,^1S \times 1\,234 \times 10^{-4}$, are in good agreement with the quantum theoretical values given by Hylleraas [4] in the formula

$$\mathrm{I\,P} = Rh\left(Z^2 - \frac{5}{4}Z + 0\,31455 - 0\,0147\,\frac{1}{Z}\right),\ Rh = 13\,54$$

	B IV	C V
I P spectr	$258\,1 \pm 0\,2$ volts	$389\,9 \pm 0\,4$ volts
theor	$258\,09$,,	$390\,12$,,

It is hoped that the accuracy will be considerably increased by measurements in higher orders and a more confident determination of the ^1P terms

From the resonance line of C V at 40 A the region is completely bare of carbon lines up to 200 A, where the principal series $2\,^2S - n\,^2P$ of C IV forms the limit of the L electron spectrum Then, including spark spectra of sufficiently high orders, the wide separation between the K and L spectra, typical for the X rays, will also appear in optical spectra

BENGT EDLÉN
Physics Laboratory, University,
Uppsala, Feb 1

[1] B Edlén and A Ericson, NATURE, 125 233, 1930, and *Zeit f Phys* 59, 656, 1930
[2] E Ekefors *Physik Zeitschr* 31 737 1930
[3] W G Penney, *Phil Mag* 9, 661, 1930
[4] E A Hylleraas, *Naturwiss*, 17, 982 1929

Fluorescence of Mercury Vapour under Atomic and Molecular Absorption

IN the letter which appears in NATURE of Jan 3, p 10, Lord Rayleigh discusses the excitation of the green fluorescence of mercury vapour by wave lengths near the resonance line λ2537 The discontinuity of intensity of the fluorescent radiation along the beam of the exciting light leads him to admit the atomic as well as the molecular absorption The hypothesis of two kinds of absorption exciting the fluorescence was further confirmed by Lord Rayleigh's investigation of the influence of the hydrogen admixture These experiments support the view that the fluorescence of mercury vapour is chiefly due to atomic absorption

I should like to point out that this conclusion agrees with that which I have drawn from my experiments on the influence of the magnetic field on the fluorescence of mercury vapour [1] In these experiments the fluorescence was excited by the light of the mercury line λ2537 The tube with the distilling mercury vapour was placed between the poles of a powerful electromagnet and the intensity of the fluorescent radiation was observed at different strengths of the magnetic field as measured at the place of excitation The variation of the intensity of the green fluorescence was found similar to that of the resonance radiation investigated by M Schein [2] The maxima and minima of the intensity of both radiations appeared at equal magnetic fields, thus indicating that the region of the excitation of the fluorescence has exactly the same hyperfine structure as the exciting line λ2537 Hence the only possible conclusion seemed to be that, in the excitation of the fluorescence of mercury vapour at moderate densities by the line λ2537, the atomic absorption forms the first necessary step of the excitation.

The evidence of my experiments referred to above and the recent work of Lord Rayleigh are decidedly against the view often expressed that the fluorescence of the mercury vapour should be produced by the molecular absorption alone

HENRYK NIEWODNICZAŃSKI
Stefan Batory University,
Wilno, Poland, Jan 30

[1] *Zeitschrift für Physik*, vol 55, p 676 1929
[2] *Annalen der Physik*, vol 85 p 257, 1928

Raman Spectrum of Hydrogen Peroxide

THE Raman spectrum of hydrogen peroxide (Merck's perhydrol 30 per cent solution in water) has been photographed The prominent feature of the spectrum is the presence of a sharp Raman frequency of 875 accompanied by a weak component at 903 The low value of the frequencies suggests that they arise from the oxygen atoms, and as such may be compared with the O_2 oscillation frequency 1552 obtained by McLennan (*Trans Farad Soc*, 25, 798, 1929) The large difference between the two values is indicative of the fact that the oxygen atoms in hydrogen peroxide (H_2O_2) and oxygen (O_2) molecules respectively are bound differently Besides the above two frequencies, there appear other bands which are less intense and sharp, the origin of which is under investigation A detailed discussion of the results obtained in relation to the structure of the molecule will appear elsewhere

S VENKATESWARAN
210 Bow Bazar Street,
Calcutta, Jan. 17

Resistance of *Eurytemora hirundoides* Nordquist, a Brackish Water Copepod, to Oxygen Depletion

THE River Tyne estuary is polluted by crude sewage and manufacturing effluents to such an extent as to cause a serious depletion in dissolved oxygen It is not unusual to find a complete absence of dissolved oxygen on isolated occasions during the summer months The number of normal estuarine organisms able to withstand these adverse conditions is very limited [1] Of these, *Eurytemora hirundoides* is the most abundant and the most hardy Its region of maximum abundance lies between 9 miles and 13 miles from the river mouth, in the area of heaviest pollution and most noticeable oxygen depletion At a survey held on July 22, 1925, it occurred plentifully in regions where the dissolved oxygen was nil, as determined by the Winkler method [1,2] During 1929 I obtained it freely in the water sampler on occasions when the oxygen content was again nil (these remarks apply to the sampling depth of 6 ft)

There are, at the present time, several investigations being made into the oxygen requirements of certain marine animals It may, therefore, be of interest to place on record the following additional observations upon *Eurytemora*, made incidentally in the course of other work

In addition to determining the dissolved oxygen *in situ* of the River Tyne at Newcastle, I have for the past two years included an additional test described as the 'dissolved oxygen absorbed' This is a modification by Jackson and Jee of the test recommended by the Royal Commission on Sewage Disposal [3] A stoppered bottle of approximately 330 c c capacity is filled with the river water (taking the usual precautions to exclude all air) and 'incubated' by complete immersion in water at air temperature for a period of seven days The oxygen remaining is de

termined Under existing pollution conditions, there are but few occasions in the summer when the residual oxygen exceeds nil Varying numbers of *Eurytemora* are usually present in the river water when sampled, and are thus included in the sample put aside for this test The following table gives a record of the ensuing mortality on these included copepods for certain dates during 1930

Date sampled	Oxygen *in situ* (gm per 100,000 gm)	Oxygen remaining after incubation (gm per 100,000 gm)	*Eurytemora*
May 23	0 44	0 045	Most alive, some dead
May 30	0 24	nil	All dead
June 6	0 26	nil	All dead
June 13	0 14	nil	All dead
June 20	0 33	nil	All dead
Aug 1	0 50	0 004	Most dead, a few alive
Aug 8	0 76	0·45	All alive
Aug 15	0 74	0 006	Few dead, most alive
Sept 5	0 58	0 004	7 present at start, 7 still alive

It is to be noted that on four of the nine occasions the dissolved oxygen has been completely utilised by oxidisable matter, and no *Eurytemora* remained alive Toxic substances may have exerted an influence in addition to oxygen deficiency It is evident that, although the copepod is regularly taken in the river under such conditions, it can survive total oxygen deprivation for short periods only Its presence in the river at these times may be explained by the continual slight aeration of surface waters by river traffic, slight though the effect may be It is clear from the table that this copepod may survive in brackish water, heavily polluted, when the oxygen concentration is no more than 0 004 gm per 100,000 gm

H O BULL

The Dove Marine Laboratory,
Cullercoats, Northumberland,
Feb 7

[1] Jorgensen, O M, The Plankton of the River Tyne Estuary, *Proc Univ Durham Philosoph Soc*, 8, 41 54

[2] Gill, R, Pollution of the River Tyne, Rept Dove Marine Lab, 1926, 28

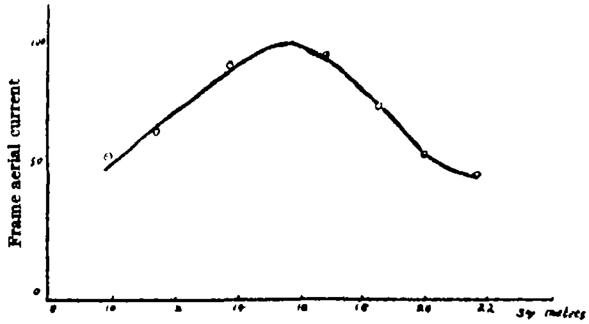
[3] Jackson, W J, and Jee, E C 9th Tees Report, Min Agric and Fish, Serial No 284, Report No 183

Optimum Dimensions of Short-wave Frame Aerials

BECAUSE of the increasing use of short waves in present day wireless practice, many investigators have studied the nature of the electromagnetic field at distances less than a wave-length from a radiating antenna The importance of such investigations lies in the fact that a knowledge of the peculiarities of the field at these short distances enables designers of directive beam aerials to space correctly the units of the radiating and receiving systems For example, for maximum forward radiation the critical spacing between a line of tuned radiating antennæ and a line of tuned reflecting wires is now known to be 0 33 or 0 85 of a wave-length and not 0 25 of a wave-length as was originally supposed [1]

The erroneous argument which leads to the result that 0 25 of a wave length is the best spacing between a Hertzian dipole oscillator and a reflecting antenna behind it, also leads to the conclusion that the best width of a frame aerial is 0 5 of a wave length A more rigorous theoretical treatment shows that, for a frame aerial, there are several different critical widths and heights which depend upon the wave-length in use, and that none of these critical values is half a wave length Although the critical dimensions are of little consequence in long wave work, they are of outstanding importance in the design of frame aerials for short waves, because the resulting current for tuned aerials can be increased many thousandfold by designing the frame with the optimum dimensions Thus a square or circular frame is always less efficient than a correctly proportioned rectangular or elliptical frame of the same area

Since both the optimum width and height are dependent on the wave length, it follows that the optimum area of a frame is also critical when used for wave lengths comparable with the dimensions In the current literature it has been assumed hitherto that the larger the area of the frame, the greater will be the radiated power or the received current, but this is not so for short waves Investigations upon which we are now engaged have shown, for example, that it is possible to double the area of a tuned frame without increasing the signal strength, even when the ratio of the height to the width is the optimum value for the particular wave length in use This is shown in the accompanying graph (Fig 1), which is based



Area of frame with optimum dimensions

FIG 1

on measurements made on 8 65 metres with a tuned frame capable of being expanded in either or both dimensions The current values are those obtained when the frame was adjusted to its optimum dimensions, and hence the currents recorded are the greatest that can be obtained with a frame of the given area Thus the greatest possible current was approximately the same whether the area of the frame was 10 or 20 square metres, and this current was reduced by any change in the relative dimensions of these frames The critical area was between 15 and 16 square metres, and then the maximum current exceeded that for frames of any other area In all cases the frame was tuned to 8 65 metres

A further point of interest is the fact that a frame designed for best reception on a given wave length is not the optimum shape for maximum radiation on the same wave length

As we have ventured to think that these preliminary results may be of some interest, it was thought desirable to write this brief note now, but it is proposed to publish the work in detail shortly, when the theoretical and experimental investigations now in progress are completed

L S PALMER
L L K HONEYBALL

The University College,
Hull, Feb 26

[1] See publications in Great Britain by Wilmotte and McPetrie and by Palmer and Honeyball, in the United States by Englund and Crawford, in France by Mesny, Chireix, etc in Germany by Meissner, Gothe, and others, and in Russia by Tatarinoff and also by Pistolkors

The Manchester Literary and Philosophical Society

By C L BARNES, Honorary Librarian

THE centenary of a society being by common consent an occasion for pride, encouragement, and hopeful anticipation, it follows that at a sesqui centenary these accompaniments should enjoy a proportionate increase With this advantage in prospect, the Manchester Literary and Philosophical Society, founded in February 1781, will celebrate its one hundred and fiftieth anniversary on Tuesday, Mar 17, when Sir J J Thomson—himself a native of Manchester and an alumnus of Owens College—will deliver an address at 4 P M in the Athenæum Hall An honorary member since 1895, he will be presented with the Society's Dalton Medal, the last award of which was made in 1919 to Lord Rutherford, who, but for the call to Cambridge, would have been president for that and the following year There will be a dinner the same evening in the Midland Hotel at 8 P M During the week, after Tuesday, the Society's house, No 36 George Street, will be open to visitors from about 11 A M to 5 P M

The Society is one of the oldest of its kind in existence Excluding the Royal Society, and various State aided academies in Continental capitals, which are not on the same footing, there are less than half a dozen provincial scientific societies in the world with so long a history The house, purchased in 1799, has externally an old world appearance, with pillars in front and a porch, finely panelled in mahogany Internally it is most attractive, and preserves an atmosphere of studious calm in a district long ago given up to commercial activities There are portraits in oils of Newton and Davy—copies of those in possession of the Royal Society—of Percival, Dalton, Joule, and other past presidents marble, bronze, and plaster busts, and a large number of engraved portraits or photographs of distinguished men of science

Of Dalton relics the Society has an unequalled collection Here are to be seen nearly all the crude chemical apparatus with which he worked, his meteorological observations, begun at Kendal, and continued for more than fifty years, many MSS of his papers, an orrery, a planetarium, and electrical appliances, his medals, including the Copley Medal of the Royal Society, and a few articles of personal property

Dalton came to Manchester in 1793, as 'professor' of mathematics—in which he had some skill—at the then new Manchester Academy He joined the Society in 1794, and read more than a hundred papers during his half-century of membership From 1816 until 1844 he was president, but had previously filled almost all the other offices He supplemented an exiguous income by taking pupils (at *1s 6d* a lesson), by lecturing, and writing books One on "The Elements of English Grammar" (1801) is said to have given him special satisfaction Though none but caretakers ever lived in the house, Dalton was allowed the free use of a room in it, and a marble tablet commemorates the fact that here, out of his experiments and cogitations, the atomic theory was developed

One of Dalton's pupils, though a paralytic stroke brought the tuition to a premature end, was James Prescott Joule, who worthily upheld the Society's prestige for about thirty years after Dalton's death in 1844 Two of the thermometers, with very large bulbs, very narrow bores, and nearly a yard long, used by Joule in his researches, are still carefully preserved, and when compared with a standard Tonnelot thermometer by Sir Arthur Schuster, about forty years ago, were found to be surprisingly accurate *

The Society found a liberal benefactor in Dr Henry Wilde, whose name is inseparably associated with the dynamo He enlarged, improved, and strengthened the premises, and provided a substantial endowment

Though these three names are more closely connected with the Society's history than any others, the bond between it and Owens College, afterwards the Victoria University of Manchester, which began in 1851, has always been very close Among presidents from one or other of these bodies may be mentioned Roscoe, Crawford Williamson, Balfour Stewart, Sir Horace Lamb, Osborne Reynolds, Sir W Boyd Dawkins, H B Dixon, F E Weiss, Elliot Smith, S J Hickson, Sir Henry Miers, and W L Bragg

Nor have distinguished non academic members been wanting To dive into the past for a moment, Dr Thomas Percival, M D, F R S, the leading spirit among the founders, and president for several years, was a friend and correspondent of Benjamin Franklin, two of whose communications, on meteorological matters, were read in 1784 The Rev William Gaskell, whose sterling merits have been eclipsed by his wife's greater fame, was a member, and William Sturgeon, inventor of the electro-magnet, also William Henry (Dalton and Henry's law is still on the chemist's statute book), Stanley Jevons, and James Nasmyth, of steam hammer fame To these may be added the Rev T P Kirkman (a distinguished mathematician whose name recalls the problem of the fifteen school-girls), John Hopkinson, Sir Joseph Petavel, and H J G Moseley, whose untimely death in the War is still mourned, and even so the list is incomplete It is worthy of note that Eaton Hodgkinson and Sir W Fairbairn, both presidents in their day, were the two upon whom Robert Stephenson chiefly relied when planning the Britannia and Conway tubular bridges, one worked out the calculations, the

* The secular rise in the freezing point of these instruments was examined both by Joule and Schuster A more recent test by Dr J. R. Ashworth (*Journal of Scientific Instruments*, Nov 1930) shows that in the principal thermometer the reading is 15 48 of the arbitrary scale-divisions, or 0 66° C higher than in 1844 it appears to be approaching a limit exponentially

other provided the metal work In more recent times, R D Darbishire, Sir W Bailey, Charles Bailey, Cosmo Melvill, and Dr H Levinstein have occupied the chair Mr C E Stromeyer has held office since 1929

The Society issues an annual volume of *Memoirs and Proceedings*, and many valuable papers are enshrined therein, as is testified by their inclusion in the Royal Society's catalogue

A special lecture, to which a premium is attached, is given once a year, and such men as Sir George Stokes, Sir Michael Foster, Sir William Ramsay, Dr Elie Metschnikoff, Prof F Soddy, the late Lord Rayleigh, Sir Joseph Larmor, Sir Charles Parsons, Sir William Bragg, and others of equal note, have responded to the Society's invitation Sir J J Thomson's name is still to be added

No mention of the Society would be complete without a reference to its library of 44,000 volumes, consisting mainly of the transactions of other scientific societies and institutions throughout the world These have been acquired by purchase or exchange over a very long period, and in most cases are complete, or nearly so The library is an outlier in connexion with the National Central Library

It is hoped by this celebration to extend the Society's influence and membership, and to make more widely known a record of which it has every reason to be proud

Experiments in Locomotive Design

IN a paper on "High Pressure Locomotives", read before a crowded meeting of the Institution of Mechanical Engineers on Jan 23, Mr H N Gresley, the chief mechanical engineer of the London and North-Eastern Railway, gave an account of the various high pressure locomotives constructed in the United States, Germany, Switzerland, and England since 1924 Prefacing his remarks by observing that at no time during the history of the steam locomotive have such radical changes been introduced as during the past ten years, he said that in Great Britain alone there are 23,000 locomotives, on which a sum of £45,000,000 per annum is expended on maintenance, renewal, and running About 25 per cent of this is the cost of fuel and another 25 per cent the cost of maintenance and renewal It will be noted that the expense in maintaining locomotives is equal to the cost of the great quantity of coal they consume From this it is clear that there is a wide field for economy if both the cost of fuel and maintenance can be reduced

In locomotives with the type of boiler as developed from that incorporated in the *Rocket* by Stephenson, boiler pressures up to 325 lb per sq. in have been experimented with but 250 lb per sq in is approximately the maximum pressure which can be carried in such boilers, having regard to the cost of maintenance It took a hundred years to increase the pressure from 50 lb to 250 lb, but during the last few years pressures have leapt up to 450 lb, 900 lb, and even 1700 lb But while high steam pressure gives greater economy in fuel consumption, it demands complications in design, and care has to be taken that the economies in fuel are not absorbed in the increased cost of maintenance of the boiler and of the machine as a whole In all the latest high-pressure locomotives, reciprocating engines have been adopted and the use of a compound engine or of a uniflow engine is essential Two-, three-, or four-cylinder compound engines have all been used in one or other of the engines described

In the United States, the Delaware and Hudson Railway in 1924 built a main line locomotive with 325 lb pressure with a two-cylinder compound engine This locomotive, named the *Horatio Allen*, was followed by the *John B Jervis* (1927) with 400 lb pressure and the *James Archbald* (1930) with 500 lb pressure The weight of these engines is between 150 and 160 tons In all three locomotives the barrel portion of the boiler differs little from the usual type The firebox, however, is formed by flat front and back water spaces joined by four circular drums two upper and two lower At the two sides of the firebox space are water tubes connecting the upper and lower drums, while the roof of the firebox is formed of tubes joining the front and back water spaces With this type of boiler about one third of the evaporative heating surface is in the firebox, instead of only about one tenth as in the ordinary boiler Superheaters are used giving a steam temperature of 700°-750° F

The German engines are known respectively as the Schmidt Henschel three cylinder compound locomotive and the Schwartzkopff-Löffler three-cylinder locomotive The first Schmidt-Henschel locomotive was built in 1926, and since then four others have been completed or are under construction The high pressure locomotive of the London, Midland, and Scottish Railway is of this type Four of the engines work with steam at 850 lb and the other at 900 lb The boilers of these locomotives consist of two—or, perhaps more correctly, three distinct parts Steam for use in the cylinders is generated in two separate boilers working at 850 lb and 200 lb respectively, but the greatest novelty in the arrangement consists of the method of heating the high pressure boiler All around the firebox are water tubes which are connected to elements in the high pressure boiler, the elements and the tubes forming a closed circuit partially filled with distilled water Owing to the heat of the fire, saturated steam is generated in this circuit at 1200 1600 lb pressure, and this very high pressure steam is used as a medium for heating the water in the high pressure boiler One advantage of this arrangement is that, owing to the use of distilled water, there is no scaling or corrosion to cause overheating of the tubes The weight of the first Schmidt Henschel locomotive was only 91 tons, but one now under construction for the Canadian Pacific Railway will have a weight of 206 tons

The Schwartzkopff-Löffler locomotive with steam at 1700 lb pressure is of still more novel construction The boiler is a most complicated system of tubes and drums with a very large number of joints and connexions, and it is difficult to believe that such arrangements can ever become standard practice Here again there are two distinct boilers, one working at 1700 lb supplying steam to the two high pressure cylinders and the other working at 225 lb pressure supplying steam to the single low pressure cylinder Neither of these boilers is subjected to the heat of the fuel or gases, the heat for the high pressure boiler being obtained from highly superheated steam generated in a high pressure superheater surrounding the fire box, while heat for the low pressure boiler is obtained from the steam exhausting from the two high-pressure cylinders The locomotive of this type was built for the German State Railways in April 1930, but is apparently not running at the present time

The Swiss engine known as the Winterthur high-pressure locomotive was completed about the end of 1927 The locomotive weighs about 90 tons and is fitted with a three-cylinder uni flow engine with cam-operated poppet valves, and exhaust passages round the middle of the cylinders Steam is generated at 850 lb pressure in a water tube boiler with one large upper drum and two small lower drums Walls of water tubes form the sides of the firebox and other water tubes partially fill the flue space, which also contains a superheater and a feed heater Trials of the locomotive have been made in Switzerland, Austria, and France, and during some recent runs a coal consumption of about 2½ lb per draw bar horse power was recorded

About half of Mr Gresley's paper was devoted to the American, German, and Swiss locomotives, while in the second part he gave an account of the locomotive No 10,000 which has been built to his designs for the London and North-Eastern Railway The steam pressure in this locomotive is 450 lb per sq in Completed in 1929, No 10,000 has since worked trains of more than 500 tons weight for long distances at express speeds with consistent success and reliability There are indications that it will prove more economical in fuel than express engines of the normal type, but economy in maintenance costs will only be apparent after the engine has run for some years In this locomotive there are two high pressure cylinders and two low pressure cylinders As in the other locomotives, the greatest interest lies in the boiler, which is the outcome of the collaboration of Mr Gresley with Mr Harold Yarrow The boiler (Fig 1) is essentially a variant of the well-known and very successful boiler first invented by Sir Alfred Yarrow for fast naval vessels In locomotive No 10,000 there is a single upper steam drum about 28 ft in length and 3 ft in diameter and two pairs of lower water drums 11 ft and 13½ ft in length respectively—one pair for the sides of the firebox and one pair for the sides of the flues Curved water tubes run from the four lower drums to the upper drum The distances between the steam drum and the water drums at the firebox end of the boiler are such that the lines joining the centres of the drums approximately form an equilateral triangle The water drums in the flue space are much closer together One interesting feature of the design is the method of supporting the upper drum from the engine framing, so that while it is prevented from moving vertically or laterally, it can expand and contract longitudinally, while another is the means adopted for ensuring the deposition of the mud in the drums and not in the tubes Experience has shown that the boiler can be worked for a much longer period than the ordinary type of boiler before requiring washing out, and although there are 1536 points at which the tubes have been expanded into the drums, there has been no case of leakage

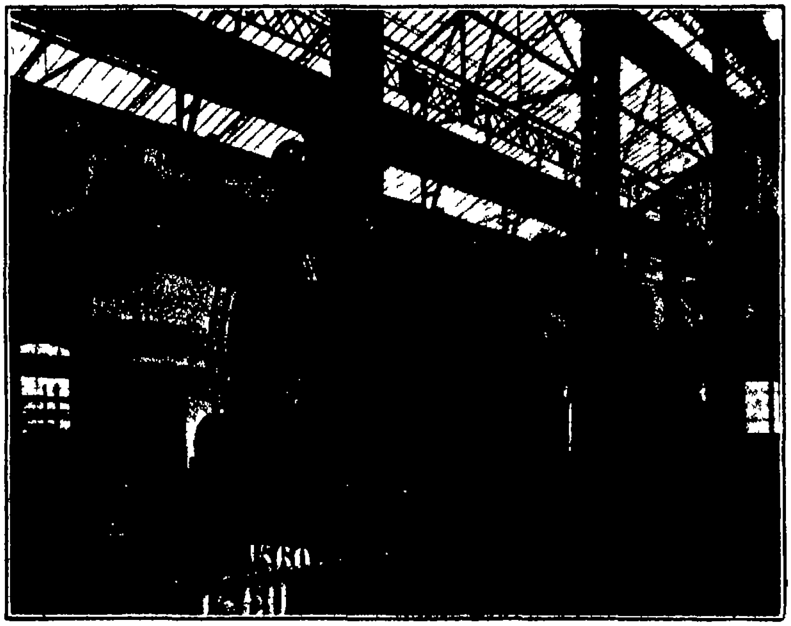


FIG 1 —Boiler, constructed by Messrs Yarrow and Co, Ltd, of the L N E R locomotive No 10,000 By courtesy of Messrs Yarrow and Co, Ltd

The ancillaries to the boiler include a feed heater and a superheater, while by surrounding the whole boiler with a double casing through which the air can circulate, all the air for combustion can be preheated to about 250° F

A feature of the locomotive which has caused public comment is the forward end, where a short funnel is housed between blinker plates This arrangement was adopted as the result of experiments made by Prof W E Dalby with the object of finding some means of keeping smoke and steam clear of the cab windows

Water Pollution Research

MAINTENANCE of the purity of our rivers and streams becomes of increasing social importance with the growth of industry, of population, and the consequent use of water to carry away waste products

On one hand is the desire to preserve the amenities of the country, to preserve fisheries providing open air recreation to many and a valuable yearly yield of salmon from several of our rivers, to meet the increasing demand for water of good quality for domestic and industrial use requiring neither expensive treatment to free it from the effects of pollution nor long and expensive pipe lines to bring it from distant unpolluted sources

On the other hand lies the necessity of disposing of sewage and trade effluents in the most economical manner, without overburdening the rivers with putrefiable or poisonous discharges Rivers can deal with relatively large quantities of such discharges, since they are soon oxidised after sufficient dilution in a stream of well oxygenated water, but when this is overstepped, death of fish, noxious smelling by-products, and the growth of fungus on the river bed result

Publicity has done much to allay the natural increase of harmful pollution during recent years Many problems have arisen When does pollution become so harmful that it is to the interest of the community to purify particular effluents, and what are the most economical means of doing so? Is it possible to do so in sufficient degree to restore or maintain the amenities of a river without putting an undue burden upon an industry or upon the local rates? In order to decide such questions, exact and accurate information, often of a very varied nature, is frequently required

In the "Report of the Water Pollution Research Board, 1929–1930",[1] an account is given of several investigations now in progress In order to obtain information of general application, especially concerning the effects on a river of sewage and trade effluents of various kinds and the quantity which can be allowed to enter without unduly retarding the process of self-purification, it was decided several years ago to make a thorough survey of the flora, fauna, and water of a typical river, and their variation throughout the seasons For this purpose the River Tees and its estuary were chosen The present Report gives a short account of the first year's work

The head waters pass within half a mile of the river's source on to a limestone bed, where in the course of only a few yards the pH value rose from 4 to 7 The water remains at about this value until it mixes with the more alkaline sea water in the estuary, throughout which the mixed waters oscillate backwards and forwards with the tides In addition, a circulatory system is set up, the ebb tidal stream being strongest at the surface and the flood tidal stream strongest at depths below one fathom This is very marked when much fresh water enters the estuary Matter suspended in the water of the upper layer has a residual movement seaward, while matter suspended in the lower layers has a residual movement towards the head of the estuary

Above the estuary the river suffers little pollution except from one tributary Series of observations throughout periods of twenty-four hours have been made to determine the changes in the river water and in the quantities of dissolved gases during the day and night Diurnal variations were found in the number of bacteria and dissolved nitrogenous compounds in the water, further investigations are being made with the aim of finding an explanation of this phenomenon

The central portion of the estuary between Stockton and Cargofleet receives the discharge of many industrial effluents and the untreated sewage from 275,000 inhabitants, which gives rise to a heavily polluted zone oscillating up and down the estuary with the tides The effluents undergo oxidation at the expense of the dissolved oxygen in the water, which may fall to below 20 per cent of saturation value during the summer, the minimum found during 1929 being 5 per cent in the central part of the polluted zone Life is almost absent in this portion of the river, where the bottom living animals and plants are also exposed to the greatest changes in salinity, while numerous species occur above it and below Various marine fishes have been found dead and dying at the lower end of this polluted belt, and great numbers of salmon smolt at the upper end as they enter it during their migration to the sea From the results obtained during the first year of the survey, the general changes in the composition of the river water at different times of year, and under different conditions of rainfall and states of the tide, have been ascertained The nature of many effluents has been examined Their poisonous constituents and influence on the water and fauna of the estuary continue to be the subject of investigation, which has proved increasingly fruitful during the second year's work

The Report deals next with the purification of effluent from beet sugar factories By using over again the wash water and by biological filtration of the effluent, this can now be rendered relatively harmless The experiments have demonstrated the conditions under which percolating filters can be operated satisfactorily thoughout a beet sugar campaign for the requisite purification of pulp press liquor, suitably diluted with river water or with effluent from the filters

The parts played by various organisms present in the filters continue to be investigated, with the object of isolating pure strains specially active in decomposing and oxidising the substances present in the effluents It is noteworthy that the work has led to the discovery of new strains of nitrifying bacteria which belong to neither *Nitrosomonas* nor *Nitrococcus*

The changes taking place in the zeolite process of water softening and the treatment of corrosive and plumbo-solvent waters are also the subject of

research Water mains sometimes become so corroded that they burst when under pressure, or deposition of organic and inorganic substances may take place to such an extent as to diminish seriously their water carrying capacity There is a lack of exact information, not only as regards the best treatment of the plumbo solvent waters, but also on the variation of this plumbo solvent character with the composition of the water

For the most economical working of the activated sludge process of sewage disposal, more precise knowledge of the various factors involved is required As the relative importance of the parts played by the bacterial and the physico chemical changes is unknown, experiments are being made with sewage effluent freed from bacteria An investigation is also being carried out on the dissolved colloids and the conditions which affect their quantity and nature

Although much of this varied research is still in the initial stage, it is abundantly clear that it cannot fail to yield many facts of scientific interest as well as of practical importance The work of the Board on the treatment of effluents from beet sugar factories has already provided a solution to an urgent social problem

The Committee appointed in May 1919 by the Ministry of Transport and the Ministry of Agriculture and Fisheries to investigate the question whether tarred roads are harmful to fisheries, has also published a report [2] containing a wealth of experimental results The toxicity towards fish of aqueous extracts from various tars has been investigated, and also the toxicity of their various poisonous constituents, phenol and higher phenols, bases such as ammonia and quinoline, and hydrocarbons such as naphthalene Similar experiments have been made with the drainage from tarred surfaces, which lose much of this toxic property after the first heavy rains have washed out the more soluble substances

The major experiment consisted in passing the rain washings from an area of tarred road into small ponds stocked with trout, through which there was a flow of fresh water These trials proved that undiluted washings from the freshly tarred roads were deadly to fish—unless diluted, for safety, with about ten times their volume of unpolluted water The subsequent drainage from the road was less toxic, but rose again where the surface began to disintegrate Parallel trials were made with rain washings which were stored or allowed to pass through a filter of cut turf, it being known that the phenols constituting tar acids and naphthalene are broken down by the action of bacteria which occur in soil In both cases the treatment was found to reduce the injurious character of the rain washings

As a result of these investigations, mostly carried out between 1920 and 1922, and the experience gained by this Committee, the Ministry of Transport warned all road authorities against the use of unsuitable tars on roads draining directly into streams It cannot be doubted that there has been a diminution in destruction of fish during the last six years The investigations are still proceeding, and include the examination of samples of home produced coal tar preparations which aim at being non-toxic, and so able to replace bitumen without danger to fisheries

H W H

[1] "Report of the Water Pollution Research Board for the year ended June 30, 1930" Department of Scientific and Industrial Research H M Stationery Office, 1930 9*d*

[2] "*Detailed Biological and Chemical Reports on Tars used for Road Surfacing* Ministry of Transport and Ministry of Agriculture and Fisheries H M Stationery Office, 1930 2*s* 6*d*

Obituary

Lt Col Sir Richard Temple, Bart , C B , C I E

We regret to record the death of Lieutenant Colonel Sir Richard Temple, the distinguished Oriental scholar, which took place on Mar 3, at Territet, Switzerland Sir Richard Temple was born at Allahabad on Oct 15, 1850, and was educated at Harrow and Trinity College, Cambridge He joined the Royal Scots Fusiliers in 1871, and after six years' service in India was transferred to the Indian Army, serving in the 38th Dogras and 1st Gurkhas After a distinguished military and administrative career, in which he served in Afghanistan and Burma, in 1895 he was appointed High Commissioner of the Adamans and Nicobars and superintendent of the Penal Settlement of Port Blair, a post which he held until his retirement in 1904 On his return to England, Temple settled on his family estate in Worcestershire During the War, as chairman of the Worcestershire Territorial Association, he took an active part in the recruiting, organisation, and training of reinforcements, and he also worked hard in connexion with the St John's Ambulance Association, of which he was assistant director, his war services being recognised in 1916 by the award of the C B

Sir Richard Temple was a quick and indefatigable worker A busy official career which would have left most men little leisure only served to afford him opportunities for increasing the range of his knowledge There were few matters connected, however slightly, with Indian culture on which he was not qualified to speak as an expert—history, religion, ethnology, linguistics, numismatics, archæology, or folk lore His census reports for Burma in 1891 and the Andamans and Nicobars for 1901 contain many noteworthy contributions to the folk lore and ethnology of these districts He had, however, long before, taken a recognised place as an authority on folk-lore by his "Legends of the Punjab" (1883–1890) and his notes to Mrs Flora Annie Steel's 'Wideawake Stories" (1884) He had also founded and edited *Punjab Notes and Queries* In Burma he made a special study of the Burmese belief in spirits, revising Burnell's "Devil Worship of the Tuluvas", and publishing his own study of "The Thirty-Nine Nats" He also collaborated with the late E H Man in a work on the languages of the Andamanese, and he elaborated a "Theory of Universal Grammar applied to Savage Languages", a scheme of which the merits have not been fully recognised An equal originality was shown in his studies of the currency systems of

backward peoples, which he maintained gave a key to the understanding of their culture Here again the acuteness of Temple's views has been appreciated by only a few experts

Temple was the author of many contributions to learned periodicals, and his wide range of knowledge made him an ideal editor of the records of early travellers and historians He was responsible for volumes produced by both the Hakluyt Society and the Indian Records series He also inspired others, and his reports as High Commissioner of the Andamans contain valuable notes made by his officers on punitive expeditions and visits of inspection among the, at that time, lesser known Andaman tribes But his greatest service to Indian scholarship was the foundation of the *Indian Antiquary* in 1884, of which he continued to be editor-in chief up to the time of his death, publishing it at his own expense In the mass of material which appeared in its pages, invaluable to the student of Indian culture, Temple leaves a monument which will endure for all time

On his retirement, Temple continued his literary and scientific activity with unabated energy In 1913 he was president of Section H (Anthropology) of the British Association His presidential address on "Anthropology as a Practical Science" was made the starting point in a campaign of which he was the leading spirit in pressing for State aid for anthropological studies This was interrupted only by the War In 1920, when he was a member of council of many learned bodies, he was also appointed director of the Royal Asiatic Society, and in 1928 he was president of the Jubilee Congress of the Folk lore Society Unfortunately, the state of his health after the War obliged him to reside for the greater part of each year in Switzerland, but this had little perceptible effect on the volume of his work He continued to produce innumerable papers and notes based upon the material he had collected in his earlier years At the time of his death, he was also engaged on a series of monographs on Indian Muslim saints, in alphabetical order, of which two sections, from A to H, are complete His mental vigour, his memory, and his mastery of detail were unimpaired to the end

PROF J S DUNKERLY

THE untimely death in his fiftieth year of Prof John Samuel Dunkerly, of the University of Manchester, inflicts a distinct loss upon British zoological science Evading publicity, and having to his credit only a comparatively small volume of published research work, he aroused full appreciation of his capabilities only in the minds of the comparatively few with whom he worked in close intimacy

Dunkerly owed the main part of his zoological training to the late Prof E A Minchin, from whom he inherited alike his most conspicuous strengths and weaknesses as an investigator—fastidious care in matters of technique and accuracy of observation, combined with a modest diffidence in his own powers which was apt to result in hesitancy to commit himself to the ready acceptance of conclusions, either his own or those of others His output of published research work suffered disastrous interference by the War, in which he did splendid service as a combatant officer—first in the Cameronians, then in the Machine Gun Corps, and finally in the Royal Air Force until shot down during the closing year of the War The wound then received resulted in severe septicaemia which left him permanently crippled and subject from time to time to attacks of severe illness and much suffering Those who were privileged to work with Dunkerly during his later years developed a profound admiration for the gay and light hearted courage with which he faced his troubles, never losing heart until the very end

Dunkerly's published researches, comparatively small in amount, deal mainly with obscure Protozoa The Flagellata took first place in his interest during earlier years, and he devoted much time to the investigation of Choanoflagellates and of the protozoan parasites infesting the alimentary canals of insects Latterly his interests centred rather on the Myxosporidia He made the first study of *Agarella*, a common parasite of the testis tubules of *Lepidosiren*, and upon this work he eventually based his most important contribution to the literature of protozoology—his study of the development and relationships of the Myxosporidia—published in the *Quarterly Journal of Microscopical Science* for 1925 In this interesting and suggestive paper, attention is directed to the parallelism in structure between the Myxosporidian, in which the amœbula—the essential reproductive element—is enclosed in complicated multinucleate arrangements of an accessory kind, the whole forming the characteristic and complex 'spore', and the Metazoon, in which the reproductive material or gonad is contained within the multicellular soma There is, of course, no suggestion of a Myxosporidian ancestry for the Metazoa the thesis supported by Dunkerly is simply the very interesting one that "the origin of the Metazoan type was, as in Myxosporidia, a development of a body or soma, originally for protection of the real individual organism represented by the germ or gonad"

From 1911 until 1926 Dunkerly held the post of lecturer on zoology in the University of Glasgow, where his efforts met with high appreciation, and where he showed himself to be a teacher of unusual gifts and power of arousing interest on the part of his pupils In 1926 he was appointed to the Beyer chair of zoology at the University of Manchester on the retirement of Prof S J Hickson

During the closing months of 1930 Dunkerly seemed to be at last restored to a fair measure of health and strength He had completed the personnel of his junior staff and was looking forward, with their loyal and enthusiastic help, to being able to run his University department at the highest possible level of efficiency It was shortly after Christmas that there became apparent the first foreshadowings of the approaching tragedy, in the form of symptoms pointing to some obscure infection of the pons region of the brain

News and Views.

Dr Walter Rosenhain, who has been superintendent of the Metallurgy Department of the National Physical Laboratory for the past twenty five years, is leaving the Laboratory in June to take up consulting work As a skilled physicist and microscopist, as well as metallurgist and engineer, Dr Rosenhain has added greatly to the instrumental means at the disposal of the metallurgist for the prosecution of his researches, while his close acquaintance with modern developments in physics has enabled him to bring the latest knowledge of atomic structure to bear upon the specific problems of the metallurgist A large amount of original research is associated with his name especially in relation to the physical structure of metals and alloys and the mechanism of failure under stress Before and during the War he was largely responsible for the development of light alloys as used in aircraft construction and for parts of explosion engines In this connexion, he investigated the mechanism of age hardening, and introduced improved methods of casting He gave much attention to the production of metals in a high state of purity, for example, chromium, manganese beryllium, and iron—the last in particular, for the purpose of the researches on iron alloys carried out for the Alloys of Iron Research Committee of the Institution of Mechanical Engineers Last year he was awarded the Bessemer Gold Medal of the Iron and Steel Institute In connexion with his metallurgical work it was necessary to give much time to the study of special refractories, and many improvements in laboratory furnaces and in metallurgical processes dependent on the use of better refractory materials are due to his initiative Dr Rosenhain has acquired an international reputation as a metallurgist

Mr C Davies Sherborn has had the degree of D Sc *honoris causa* conferred upon him by the University of Oxford in recognition of his work on the "Index Animalium", the final parts of which are now ready for, if not actually passing through, the press It is just forty years since Dr Sherborn began his self imposed task of providing an index to the scientific names that have been given to animals by systematic zoologists since the time of Linnæus The first part, containing the names published between 1758 and 1800, was issued by the Cambridge University Press, as a volume of 1254 pages, in 1902 The publication of the second section, bringing the record down to the year 1850, was begun by the Trustees of the British Museum in 1922, and twenty four parts have been issued since that time, containing in all 6118 pages and carrying the index to midway through the letter 'S' The total number of names so far indexed amounts to more than 400,000 These figures give some impression of the magnitude of the task When it is added that the names had to be collected by laboriously searching the files of innumerable scientific periodicals and separate works, many of them rare and difficult to obtain, and that questions of authorship and date of publication often involved prolonged and difficult researches, it seems almost incredible that the task should have been accomplished single-handed Every one with experience of bibliographical work will appreciate the courage required to plan such an undertaking, and the tireless industry and self sacrificing devotion that could alone carry it to completion Zoologists of the greatest eminence all over the world have borne testimony to the value of Sherborn's work, and letters expressing the most unqualified appreciation have recently been received from Stockholm, Copenhagen, Berlin, Frankfort, Paris, New York, and Washington His many friends in Great Britain and abroad will learn with pleasure of the high, but abundantly merited, distinction that has been conferred upon him

The following were elected fellows of the Royal Society of Edinburgh at a meeting held on Mar 2 W A Bain, assistant in the department of physiology of the University of Edinburgh, W M Baird, fellow and past president of the Faculty of Surveyors of Scotland, Dr T P Black, head of mathematics department, Trinity Academy, Leith, Prof J A Carroll, department of natural philosophy, University of Aberdeen, Dr J M Cowan, assistant keeper, Royal Botanic Garden, Edinburgh, J Crichton, assistant superintendent, Meteorological Office, Edinburgh, Dr Shepherd Dawson, principal lecturer on psychology, Training College, Glasgow, Philip Eggleton, lecturer in biochemistry in the department of physiology, University of Edinburgh, Dr W R D Fairbairn, consultant physician and lecturer in psychology, University of Edinburgh, Robert Grant, publisher (Oliver and Boyd, Edinburgh, Gurney and Jackson, London), Dr J R Greig, director, The Moredun Institute Animal Diseases Research Association, Gilmerton, J Henderson, manager and secretary, Edinburgh Assurance Co, Ltd, Prof T Johnson, Tomeg, Hillview, Corstorphine, Dr J du P Langrishe, lecturer in public health, University of Edinburgh, N M H Lightfoot, lecturer in mathematics, Heriot Watt College, Edinburgh, Dr W J McCallien, lecturer in geology, University of Glasgow, Dr W H McCrea, lecturer in mathematics, University of Edinburgh, Dr J B McDougall, medical director, British Legion Village, Preston Hall, Kent, J H. Mason, veterinary research worker, London, F C Mears, architect, 3 Forres Street, Edinburgh, Dr A. Nelson, lecturer in agricultural botany, University of Edinburgh, Dr J Phemister, senior geologist, H.M Geological Survey of Scotland, W Robb, director of research, Scottish Society of Research in Plant Breeding, Corstorphine, Midlothian, H S Ruse, lecturer in mathematics, University of Edinburgh, J J M Shaw, lecturer in surgery and clinical surgery, University of Edinburgh, J F Shearer, lecturer in natural philosophy, University of Glasgow, G A Steven, assistant naturalist at the Plymouth Laboratory, Marine Biological Association of the United Kingdom, Dr C P Stewart, lecturer in general biochemistry, University of Edinburgh, D Cleghorn Thomson, Scottish regional director, British Broadcasting Corporation, Dr W J Walker, research

chemist, H.M. Fuel Research Station, East Greenwich, London, Prof John Walton, department of botany, University of Glasgow, Right Hon T B Whitson, Lord Provost of the City of Edinburgh, Dr J Wishart, statistician, Rothamsted Experimental Station, Herts

ON Mar 2, the House of Commons passed, by a large majority, the second reading of a bill to regulate the protection of grey seals in British waters At present the grey seal is protected during the greater part of its breeding season, but its protection comes up for review annually and depends for its continuance on the Expiring Laws (Continuance) Bill If the new Bill becomes law, protection will be guaranteed, with this proviso, that the Minister of Agriculture and Fisheries for England and the Secretary of State for Scotland may withdraw protection during the breeding season, either wholly in any breeding period or during part of the period, or in any specified area during the whole or part of the breeding season The statements made in the House by the official supporters of the Bill were admirably moderate and we have no doubt that the Ministers concerned will consult opinions other than those of interested parties before deciding upon any relaxation of the present protection Other statements made in support of the Bill were less admirable Sir Robert Hamilton cited against the grey seal the case of a gentleman who had shot about a thousand seals in re establishing a salmon fishery But surely the seal in question was the common seal, a coast loving and estuarine species, the habits and distribution and frequency of which are very different from those of the seal which Sir Robert Hamilton was attacking We direct attention to this false argument because we have on other occasions noted a tendency to drag in against the grey seal irrelevant accusations based on the well known depredations of the common seal

ON Mar 7, and again more strongly during the early morning of Mar 8, severe earthquakes were felt over a large part of the Balkan peninsula causing much damage and some loss of life Many buildings have been destroyed at Valandovi, Strumitza, and Demirkapu, and there has been some, if perhaps less, damage at places so far apart as Sofia, Kustendil, Nevrokop, Gorna Jumaya, and Svetivratch, that is, within an area about 100 miles in diameter The shock was felt at Adrianople, Nish, and Salonika, and thus the disturbed area, as indicated by the early reports, must have been at least 350 miles long from east to west, extending in the latter direction to the neighbourhood of Skutari, and about 200 miles wide The epicentre probably lies about 100 miles to the north of Salonika, and close to one of the most active zones (that of Rilski Monastir) in the central portion of the peninsula One feature of the earthquakes that may prove to be of interest is their possible connexion with the Bulgarian earthquakes of three years before A brief report on these earthquakes by Prof G Bontcheff has recently appeared in the *Matériaux pour les Études des Calamités* (No 22, pp 98-116, 1930) The epicentre of the earthquake of April 14, 1928, lay near Tchirpan, that of the earthquake of April 18 near Plovdiv (or Philippopolis), about 25 miles to the west In the recent earthquake, the seat of activity was transferred about 80 miles still farther in the same direction

ON Mar 4, Sir William Bragg gave a lecture on Michael Faraday which formed one of the series of National Lectures arranged by the British Broadcasting Corporation As Fullerian professor of chemistry, Sir William spoke as Faraday's successor in the laboratories and lecture room of the Royal Institution, and a special interest invested his account of the great experimental philosopher's life and work in view of the forthcoming celebration of the most notable of his discoveries, that of electro-magnetic induction Aug 29 1831, is the date of the first successful experiment in the induction of electric currents, and in this the centenary year some time was naturally given to an explanation of the nature and significance of the electrical researches, but within the limits of the time set for his talk, Sir William also gave a very interesting account of the man himself, of his early life as a bookseller's apprentice, his introduction to Davy and to scientific work, his lovable character, and of the vision which filled his mind and directed and informed all his experimental inquiries—that of the essential unity of Nature and of the relations to be sought between its different manifestations Faraday could have had no more sympathetic interpreter, and many who listened must have caught something of the personal magnetism which gave to his own lectures their charm and drew Victorian audiences to the Royal Institution

Two series of Faraday s electrical experiments were described in some detail first, those on the induction of electric currents, leading up to the recognition, the real 'discovery' of electro magnetic induction, that the induced current was only obtained at 'make' and 'break' of the inducing voltaic circuit, followed by the induction of electric currents in a closed conducting circuit by mere approximation of a permanent magnet The second set of experiments were electrostatic, and culminated in the famous one in which he constructed a great 12 ft cube, and by standing inside it with an electroscope proved that an electric charge resides on the outside of a conductor, or rather, as he saw it, exists as a state of tension in the medium which surrounds it Sir William concluded his talk with a brief but most interesting reference to Faraday's religious life He belonged to a small and little known sect, the Sandemanians, the tenets of which he held faithfully throughout his life Although it is a natural impulse to seek some connexion between his science and his religion, Faraday himself apparently regarded them as two separate and distinct things, and his reserve in religious matters was such that we are left with little upon which to base an opinion as to his personal attitude towards them

IN his Friday evening discourse on Mar 6 at the Royal Institution on "Ozone in the Upper Atmosphere and its Relation to Meteorology", Dr G M B

Dobson described the chief results which have been obtained from researches on the ozone in the upper atmosphere carried out in many parts of the world during the last five years The methods were described whereby the amount of ozone can now be accurately measured with ease in a few minutes The ozone, which is situated at a height of some 50 km above sea level, has a well marked annual variation which is different in different parts of the world At all places outside the tropics, there is a maximum in the spring and a minimum in the autumn, the range being greatest in high latitudes and least in low latitudes In temperate regions there are also large changes from day to day which are closely related to the weather conditions, cyclones and anti cyclones each having their own characteristic distribution of ozone It is not at present understood how this relation is caused, since the ozone is much higher in the atmosphere than most of the processes affecting the weather Neither is it known at present with certainty how the ozone is formed The ozone in the upper atmosphere is responsible for shielding the earth from intense ultra violet radiation from the sun, which would cause serious effects if it reached the surface It further causes the upper atmosphere at a height of 40 50 km to be at a temperature in the neighbourhood of the normal boiling point of water This, in its turn gives rise to the zones of abnormal audibility of sound from large explosions at a distance of some hundred miles from the explosion itself

THE British Optical Instruments Manufacturers' Association has issued an attractive booklet as a souvenir of the exhibit at the recent British Industries Fair It gives a summary of some of the outstanding advances in optical instruments since the War, and includes an interesting section illustrating the multifarious uses of scientific instruments in various industrial operations The industry is entitled to take a real pride in many of these recent achievements, and although no names are mentioned in the booklet, we find well deserved references to the instruments and especially the interferometers of Messrs Adam Hilger, Ltd , the $f/2$ anastigmat lenses of Messrs Taylor, Taylor and Hobson, Ltd , the fine-adjustment mechanisms for the ultra violet microscopes of Messrs R and J Beck, Ltd , the wide angle binoculars of Messrs Ross, Ltd , and productions of other firms too numerous to mention here It is certainly true to say that such advances have only been made possible by the most strenuous of efforts As the president of the Association said in 1925, in reference to the post War slump, "Then came the time of readjustment, of a dearth of orders that bordered on starvation , but the trade drew the belt tighter and tighter, hung on, and responded to that severe stimulus by an effort of experiment and development which is without precedent in its history" This effort still continues, and if, as we understand, it is now resulting in a rising level of activity and prosperity in the industry, then success will be well deserved

THE optical trade has certainly enjoyed a measure of protection, but the opportunity has been taken to strengthen the foundations of scientific control, the activities of the British Scientific Instruments Research Association, the National Physical Laboratory, the Technical Optics Department at the Imperial College of Science and Technology, and the Optical Society have created an entirely new atmosphere in which progress is appreciated at its true value The achievements are mainly, however, brilliant individual performances , unfortunately perhaps, the kind of competition that must be faced is a very large co operation of brains, capital, and labour organised on a big scale With the utmost pride in British firms and their unbeaten products, we must not forget the fact that big things are being done elsewhere Planetariums, stereo planigraphs, and the like, are no mere rumours Even if sometimes these 'big noises' are more useful as advertisements than as commercial ventures, the trade cannot afford to forget the advertising power of spectacular things, or that two designers of experience, working whole heartedly together, will usually achieve something much better than is possible to either working alone

IT is announced in *Chemistry and Industry* for Feb 20 that the International Atomic Weights Commission will meet for the first time since the War In the issue of Jan 30 it is stated that the Federal Council for Chemistry, in view of the progress made in ensuring the truly international character of the Union Internationale de Chimie, has decided to dissolve the existing committees on the chemical elements and to appoint a new international committee This is to consist of G P Baxter (United States), O Hönigschmid (Munich), P Lebeau (Paris), R J Meyer (Berlin), and Mme Curie Prof G Urbain has been elected honorary president of the committee The committee is charged with the duty of preparing an annual international table of atomic weights New committees on isotopes and radio active elements are in course of formation A letter from Dr F W Aston, which appeared in NATURE for Dec 20, 1930, is of interest in this connexion The 'unit' of atomic weights has for some time been oxygen (16), originally introduced because the values of Stas were based more or less directly on this standard Very few of the newer values have, as a matter of fact, been referable directly to oxygen, and Dr Aston has now directed attention to the further difficulty introduced by the recent discovery that oxygen is not a simple element but a mixture of isotopes The use of a mixed element as the standard of atomic weights would seem undesirable

BARON GIAN ALBERTO BLANC, professor of geochemistry in the University of Rome, has, during the past twelve years, successfully attacked the problem of extracting alumina and potash salts from leucite, a mineral consisting of a silicate of alumina and potash which exists in very considerable amounts in the volcanic rocks of central Italy and hitherto considered worthless In the course of a public lecture before the Institution of Chemical Engineers at the Institution of Civil Engineers on Mar 5, Baron Blanc said that the first problem with which he was confronted was to find a practical means of separating

the alumina and the potash from the silica This was solved by a new method of attack of the silicate by acids, which allowed an easy and complete elimination of the colloidal silica from the solution Some years ago, Prof J W Hinchley directed the attention of the English technical world to this process, and it is at present used in England by Peter Spence and Sons for the manufacture of alum by the treatment of leucite with sulphuric acid The problem of separating the salts obtained by the acid treatment, so as to produce the potash as a fertiliser and the alumina for metallurgical and chemical work, was then attacked Finally, by thermal decomposition of the aluminium salt, a new type of chemically active aluminium oxide was obtained, which has proved much more suitable for the production of aluminium than the aluminium oxide obtained through calcination of the hydrate One of the characteristic features of the Blanc process is that it requires only a very limited amount of fuel A large plant for the treatment of one hundred metric tons of leucite per day is now being completed at Aurelia, near Rome, and will soon be working The supply of leucite of which Italy can dispose is calculated in milliards of tons

At the close of the annual corporate meeting of the Institution of Chemical Engineers held on Mar 6, the retiring president, Mr Arthur J Reavell, opened a discussion on the education and training of the chemical engineer After referring to the pamphlet on this subject issued by the Institution in 1925, he expressed great dissatisfaction with the present method by which a student is now usually trained in chemical engineering, by first taking a degree course in chemistry The result is an ill balanced course, very deficient in engineering training He thinks that engineering is the most important subject and should be taken first A well balanced training would consist of two years' work with the engineering, physics, and chemistry students, utilising the existing organisations in these subjects, followed by two years' work in the chemical engineering laboratories, and the final attainment of a degree in that subject Such laboratories, however, should have far more comprehensive equipment than they have at present

Sir Frederic Nathan explained that the pamphlet on the "Training of the Chemical Engineer" published by the Institution in 1925 was produced by the assistance and approval of industrialists throughout Great Britain Since that time, two schools in London—a third has just been started—have been giving instruction on the lines of this pamphlet There is no difficulty in obtaining employment for such men, but Sir Frederic believes that students should be entered for chemical engineering right from the beginning of their university training Sir Robert Robertson did not agree with Mr Reavell he thinks that the training should be essentially one of chemistry, to be followed by a 'top dressing' of engineering and chemical engineering, and he was supported by Mr McKillop (British Dyestuffs Corporation) Mr Heron Rogers is of opinion that a student of good calibre can be trained to be both a good chemist and a good engineer, and become an expert in these subjects and also in chemical engineering After Mr Rintoul had emphasised the fact that a university cannot produce chemical engineers, but that works training is essential, Dr Dunstan (Anglo Persian Oil Co) explained how his company is training and utilising university graduates as chemical engineers Mr C S Garland (Steatite Products, Ltd) emphasised the measure of agreement among the speakers with a demand for a special branch of university training so that the student may enter as a chemical engineering student and take a well-balanced course involving all those subjects necessary to the profession of a chemical engineer The discussion was closed by Mr Tizard, who pointed out that the problem is a special case of the adaptation of university training to industry and industry to university training He sees no reason why chemical engineering should not be accorded a similar organisation at the universities as electrical engineering and mechanical engineering

At the fifty third annual general meeting of the Institute of Chemistry, held on Mar 2 at the Institute, Russell Square, the president, Dr G C Clayton, presented the Meldola Medal to Dr R P Linstead, of Imperial College of Science, and the Sir Edward Frankland Medal and Prize, for registered students, to Mr G Broughton, of the Royal Technical College, Salford In submitting the report of the council, the president remarked on the increase in membership, which now comprises over 5850 fellows and associates The financial position is also satisfactory The legal and parliamentary committee has been more than unusually active, having dealt with such matters as chemical patents, service agreements for chemists, the Dyestuffs (Import Regulation) Act, the regulations dealing with methylated spirits, and a proposal to present a petition to H M the King in Council for a supplemental charter, in order to acquire for the fellows and associates the right to use the title 'Chartered Chemist' The Council is of opinion that it is desirable that members of the Institute should acquire this title, in order to distinguish them from pharmaceutical chemists The meeting considered the adoption of the petition for the supplemental charter, but, although on a division supported by a decided majority, it was referred to a postal vote

An experimental room has been set up at the London School of Hygiene and Tropical Medicine in which it is possible to reproduce by means of an air-conditioning plant varied climatic conditions and any temperature, humidity, or air movement which may occur in factories or mines Experimental subjects rest or work under the conditions to be investigated, and by observation of the pulse, body temperature, skin temperature, loss of weight due to sweating, and expenditure of energy by measuring the air breathed and oxygen used, it is possible to study the effect of such air conditions on the human body Formerly the carbon dioxide percentage in the air was regarded as the best index of good or bad ventilation, until Sir Leonard Hill proved conclusively that it is not the percentage of carbon dioxide in a badly ventilated room which causes the sensation of discomfort and stuffiness, but the physical properties

of the air and their influence on the temperature re gulating mechanism of the body Sir Leonard Hill's kata thermometer assesses the cooling effect of these environmental factors in one measurement, namely, the rate of cooling, or cooling power It has been shown that certain cooling powers are suitable for sedentary work, or light or heavy manual work, and thus, so far as possible the ventilation and heating systems in buildings or factories or mines should ensure that these desirable cooling powers are maintained Investigations in mines by Dr H M Vernon, of the Industrial Health Research Board show that working capacity declines and accidents increase in frequency if the cooling power of the en vironment is too low and throws too great a strain on the body

The Council of the British Association has resolved to nominate Sir Alfred Ewing lately Principal and Vice Chancellor of the University of Edinburgh, as president of the Association for the year 1932

At the annual corporate meeting of the Institution of Chemical Engineers held in London on Mar 6, the Osborne Reynolds Medal (1930) was presented to the retiring president Mr Arthur J Reavell, by Sir Alexander Gibb The Moulton Medal (gold) was presented to Mr A T King for his paper on the "Treatment of Suint Liquors" The Junior Moulton Medal (silver) was awarded to Mr L W Blundell for his paper on the "Manufacture of Hydrogen Peroxide"

We have received a copy of the *Engineer* Directory and Buyers' Guide for 1931, which, besides classified lists of engineering firms advertising in that journal, with their telephone numbers, telegraphic addresses and the codes used, contains a list of the technical headings used in the directory, with translations in French, German, Italian, and Spanish A list is also given of the British Standard Specifications and Reports The directory is published annually and is issued free of charge

Applications are invited for the following ap pointments on or before the dates mentioned — A lecturer in natural and agricultural sciences at Harrison College, Barbados—C A, The Secretary, Board of Education, Whitehall, S W 1 Scottish candidates to C A, The Secretary, Scottish Educa tion Department, Whitehall, S W 1 (Mar 30) A lecturer in geography at St Gabriel's Training College, Camberwell—The Principal, St Gabriel's Training College, Camberwell (Mar 30) A superintendent of the Metallurgy Department of the National Physical Laboratory—The Director, National Physical Labora tory, Teddington (Mar 31) A lecturer in geography at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (April 11) A professor of brewing in the University of Birmingham—The Secretary, The University, Birming ham (April 20) A lecturer in natural philosophy in the University of St Andrews — The Secretary, University of St Andrews, St Andrews (April 22) An assistant lecturer in metallurgy at the County Tech nical College, Wednesbury—The Director of Educa tion, County Education Offices, Stafford (April 23)

Our Astronomical Column

The Elongation of Eros – The *Daily Science News Bulletin* for Feb 6 issued by Science Service Washing ton, D C, contains some details of the elongation of Eros, they are based on a telegram from Johannes burg, transmitted through the I A U Bureau, Copen hagen, and on observations by Mr Leon Campbell at Harvard It is concluded that the long diameter of Eros is 25 to 29 miles, and the axis of rotation 8 to 10 miles The long diameter must be in the equatorial plane, and the earth must have been in this plane at the time when the light variation was at a maximum, about last December, the slight dissymmetry between the two maxima would be explained by difference of albedo of the opposite faces The exact time of rotation of Eros is given as $5^h\ 16^m\ 12\ 94^s$, but there are two maxima and two minima in this period *Bulletin* 187 of Kwasan Observatory, Kyoto, gives $2^h\ 38^m\ 4\ 546^s$ for the half period

The observations at Johannesburg were made by Dr W H van den Bos and Mr W S Finsen, using the 26 inch refractor of the Union Observatory The explanation of the light variation by the departure of Eros from a spherical form is antecedently more probable than by the hypothesis of variable albedo of different portions of its surface, the variations of albedo would have to be extremely great to pro duce so marked a change of light

The Variable Star with the Shortest Known Period *Bull* No 214 of the Astronomical Institute of the Netherlands contains an account of the discovery of this variable, the position of which for 1900 is R A $8^h\ 19^m\ 38^s$, S Decl 18° 44 9′ Mr H van Gent, of Leyden Observatory, who is now at the Union Observa tory, Johannesburg, detected the light variation by comparing two plates in the blink microscope Several earlier plates containing the star had been sent to Leyden and these have been examined by Mr A J Wesselink and Prof E Hertzsprung The period is 0 069746 days, or 100 4 minutes A difficulty arises, since the magnitude is about 14 to 15, and an exposure of some thirty minutes is needed to show it clearly when near minimum, this is such a large fraction of the whole period that photography is unsuitable for obtaining the light curve Visual observations have now been made at Johannesburg The light curve is drawn as a simple sine curve, the light range being one magnitude

Photographic Photometry of the Magellanic Clouds —*Bull Astr Soc Netherlands*, vol 6, No 209, con tains a study of the Magellanic Clouds by G van Herk, of the Lembang Observatory The method was that of extra focal images, the size and black ness of the images being measured The images of the cloud are compared with those of stars of known magnitude

Diagrams are given, showing the isophotic lines in the two clouds Each has an elongated nuclear region of greatest brightness not far from the centre The large cloud has a second, less bright nucleus, not far within the northern border of the cloud The isophotic lines embrace each nucleus with an approach to regularity, and an ill defined ligament connects the two nuclear regions The structure of the small cloud is much simpler and more regular

The integrated light of the large cloud is found to be 1 2 mag, of the small cloud 2 8 mag Hubble had found 0 5 mag for the large cloud, and Paraskevo poulos 1 8 for the small

Research Items

Bushman Paintings in Eastern Cape Province.—Mr. John Hewitt and Father P. Stapleton, S.J., in vol. 4 of the *Records of the Albany Museum*, Grahamstown, South Africa, describe paintings and artefacts discovered in rock shelters near Cala. Rock paintings in this area are very numerous, but have never been described in detail. The locality of the present investigation is Tembuland, which is east of the Drakensberg and south of the Stormberg. At Rebels' Kloof a great number of implements were found and the rocks were covered with paintings, some of fine technique but in poor preservation. In one case there were some very remarkable human figures with attenuated limbs in white. Other paintings of apparently the same age showed carnivores, elands, etc. Another series of human and animal figures was entirely in black, including a well drawn black elephant. A rock shelter on the other side of the river contained a fine series covering nine or ten yards, with excellent decorative effect. The biggest figure is an eland in dark red and white. Yellow and white paintings here seem to be the most recent. Two human figures in chocolate, and faint, may be older. Not far distant was a hunting group in white. The hunter is approaching a herd of reboks, mostly at rest, with a 'gargantuan stride.' High up on the krantz, and inaccessible, near beautiful elands, were two human figures, remarkable for the fact that they wear skin capes reaching to the knees, giving the figures quite a European appearance. The faces are white broadly bordered with chocolate bands, which is also the colour of the legs. As regards the artefacts, the major stone industry belongs to a group included in the Smithfield cultures. The pottery of Rebels' Kloof shows two distinct industries.

Uterine Cycle in the Marsupial *Bettongia*.—The species examined by Prof. T. Thomson Flynn, *B. cuniculus*, is one of the 'rat kangaroos' of Tasmania, and the investigation adds usefully to the known facts concerning the reproductive phenomena of the diprotodont marsupials (*Proc. Linn. Soc. N.S. Wales*, vol. 55, 1930, p. 506). The species has several breeding seasons in the year, and there may actually be an overlapping of the gestatory and lactatory periods. Only one young is born at a time, but there are four teats in the pouch, so that three are unoccupied at a time, a condition the reverse of that in another marsupial group where the young exceed the teats in number. Hill and O'Donoghue have pointed out that marsupials show a progressive reduction in the number of teats present in the pouch, but there is also a progressive reduction in the number of the young, and this reduction has reached its limit in cases such as the present where reduction in number of young has proceeded in advance of teat reduction. Pregnancy is unilateral, and in normal circumstances occurs alternately in each uterus; but when one uterus is pregnant the other enters into and remains in a state of pseudo-pregnancy, which persists until parturition. In view of the likelihood that the ancestral marsupial was a placental mammal, it is interesting to find that this specialised form has only a small allantois, with no allantoic placenta; but the nutrition, respiration, and elimination of waste products of the fœtus are efficiently carried out by a yolk sac placenta.

Hydromedusæ in the North Sea and Channel.—Dr. P. L. Kramp, in "Hydromedusæ collected in the South-western Part of the North Sea and in the Eastern Part of the Channel in 1903–1914" (*Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, No. 45, 1930), describes the Hydromedusæ from those parts of the North Sea and Channel which were allotted to Belgium as its share in the International Plankton Research. The region is limited to the east by a line from the mouth of the river Schelde to Lowestoft, and to the west by a curved line from Fécamp to Newhaven. Most of the material was collected during the quarterly cruises (February, May, August, and November) at a number of fixed stations, supplementary collections being made in other localities and in other seasons. The rough results have already been published in the *International Bulletin*, but, so far as the medusæ are concerned, only a small part of the material was submitted to specialists. Twenty-nine species are now recorded, one of which is new to science. Five sections are recognised in the area investigated: the first in the eastern part of the Channel, the third in the shallow water along the North Sea coasts of France and Belgium, the second in the Straits of Dover, being a transition area between two and three; the fourth, the mid-water region in the North Sea between the coasts of France, Belgium and England, which is a mixture of indigenous forms and species from the Channel; and the fifth, the English coastal region from Dover to Lowestoft, which is like the fourth but less prolific. Conclusions as to the influence of 'Channel water' on the presence of medusæ show that indigenous North Sea species are particularly abundant there when there is little Channel water, and those few medusæ which come from the Channel are almost wholly found in the North Sea sections when the 35 per mille isohaline has a particularly extensive distribution. The new species *Trissocoma brownei* is of special interest. It was first observed by E. T. Browne—in the Channel and at the south-west coast of Ireland—who realised that it was a new species. Dr. Kramp has now found it in fair abundance in his fourth section in two localities between Zeebrugge and Orford Ness, and placed it in the new genus *Trissocoma*, having its natural position between *Cosmetira* and *Mitrocoma*.

Respiration in Higher Plants.—The *Proceedings* of the Seventeenth Indian Science Congress (Calcutta: Asiatic Society of Bengal), held at Allahabad in 1930, contains the presidential address to the Botany Section delivered by Prof. P. Parija. This deals chiefly with the respiration of cherry laurel leaves in air, in nitrogen, and in mixtures of oxygen and nitrogen, and with the interpretation of the results. In partially starved leaves, the effect of nitrogen was to increase slightly the respiration rate, and then, on returning the leaves to air, a considerable increase in carbon dioxide production was observed, the so-called 'after effect.' In nitrogen (or anaerobic) respiration two atoms of carbon are assumed to accumulate as intermediates to every carbon atom appearing as carbon dioxide. If, on admitting oxygen, all the intermediate substances were oxidised to carbon dioxide, the maximum increase of carbon dioxide production in the 'after effect' should therefore be twice the nitrogen respiration, and this is, in fact, the case after long periods (48 hours) of respiration in nitrogen. After shorter periods of two to thirty hours in nitrogen, however, the 'after effect' is only of the order of 1.1 times the respiration in nitrogen, and it is assumed, in agreement with other evidence, that the difference between the theoretical value of 2.0 and the value given is due to the oxidative building up of the remainder of the intermediates. Prolonged exposure to nitrogen is supposed to inactivate the mechanism which brings about the latter method of disposal. On exposing the leaves to different mixtures of oxygen and nitrogen, it is found that there is a minimum production of carbon dioxide when the

mixture contains 5 per cent of oxygen, and maxima in pure nitrogen and in 33 per cent of oxygen The 'after effect' is only observed when the proportion of oxygen is below 5 per cent, although an increase in carbon dioxide production of a different type is observed when the proportion of oxygen is greater than that in air

Oxidation and Reduction in Bacteria—The influence of various conditions on acetic acid formation by *B pasteurianum* has been further studied by Hiroshi Tamiya and Kiyoshi Tanaka (*Acta Phytochimica*, **5**, 167), with special reference to the suggestion that quinone may replace oxygen as a hydrogen acceptor in this type of fermentation They find that carbon monoxide is wholly without influence on the production of acid in the presence of quinone, but greatly reduces it in the presence of oxygen Toluol also delays the fermentation in the presence of oxygen, but influences the reaction only slightly in the presence of quinone or methylene blue In the acetic acid bacteria, the indophenol reaction for oxidase is also reduced by carbon monoxide and toluol, although the latter was found to have no effect on the action of a *Lactarius* extract The explanation given is that the normal function of cytochrome is disturbed by quinone and toluol, and it is concluded that the results agree with the theory that cytochrome acts as a regulator of oxygen pressure in this type of oxygen fermentation, as well as in the oxygen respiration of other plants and animals The same publication (p 119) also contains results by these authors and Tatsutaro Hida on the reduction of methylene blue by acetic acid bacteria (as an intracellular enzyme), by liver extract (as a free dehydrase), and various chemical agents (pyruvic acid and aceto acetic ester) In all cases light is found to accelerate the reduction, a photochemical activation of methylene blue molecules being postulated as the cause Carbon monoxide has no influence on the purely chemical reduction nor on the action of liver extract, but it markedly retards the action of *B pasteurianum* Quinone slows down all three types of action

Bituminous Sandstone, Vernal, Utah—Appropriately named "Asphalt Ridge", there occurs a series of low discontinuous hogsbacks of bituminous sandstone, south west of Vernal, Utah, U S A, which have recently been the subject of investigation by Mr E M Spieker (*U S Geo Sur Bull* 822 C) Most of the sandstone is of the Eocene age, and analyses show that the bitumen content ranges from 8 to 15 per cent by weight Mechanical analyses were conducted to determine the various grade sizes and proportions of such grades present in the sand, the average of the results given shows that the rock is of medium grade The density varies from 1 99 to 2 03 The specific gravity of the sand as extracted is about 2 63, slightly less than that of pure quartz Porosities are also variable, between 29 5 and 38 per cent Apparently some samples gave exceptionally high porosity values, 47 to 49 per cent it is pointed out that the usual pore space of an aggregate of identical spheres is 47 64 per cent, but on the whole the evidence does not suggest that this particular sandstone is composed of markedly rounded grains, so that these high values are not characteristic It is gratifying to note that so much attention has been given to mechanical and textural composition of these rocks, as frequently these vital properties to impregnation are passed over sketchily in favour of fuller description of the bitumen It is anticipated that mining of this bituminous sandstone can be carried back some 1½ miles from outcrop, and thus over the area it is possible to estimate resources of some 1,970,000,000 tons of impregnated rock The sandstone has already been successfully used for street paving in Vernal It is hoped to use the bitumen as a source of motor fuel by hydrogenation processes, but it is not clear whether the rock lends itself to easy and cheap extraction, or by what method this will be accomplished on a commercial scale

Red Rain in Victoria—Mr Frederick Chapman, Palæontologist of the Australian Commonwealth, has continued his observations on red rain in south eastern Australia which he began in conjunction with H J Grayson in 1903 We are unable to print Mr Chapman's communication in full, but his observations are summarised below On the night of Dec 31, 1927, after a strong northerly wind had carried thick clouds of dust over Victoria and blown the finer particles southward over Bass Strait, there were heavy but irregularly distributed falls of red rain Mr Chapman estimated the amount deposited in Balwyn, a suburb 8 miles east of Melbourne, at 51¾ tons per square mile the Commonwealth Meteorologist, Mr H A Hunt, estimated the deposit at Elsternwick at 24 tons per square mile The red dust on this occasion was exceptionally sticky, as the innumerable diatoms—*Nitzschia* and *Cocconeis*—still contained their endochrome The red stains on leaves and flowers in the gardens were retained for days and even weeks The impressions on glass indicate that each raindrop was coated by a thin film of the dust On Nov 3, 1920, after a northerly gale, showers of red rain fell at 7 P M and after 9 P M The amount of the red sediment collected in a vessel in Mr Chapman's garden indicated a fall of 64 tons to the square mile, or if it had been equally distributed over Victoria, a fall of nearly six million tons in that State Both the minute reddish flakes of sediment and the diatoms and sponge spicules show that the material had been derived from the arid regions in the north west of Victoria and in Central Australia

Climatic Changes in East Africa—In a recent lecture to the Royal Geographical Society, Dr L S B Leakey gave an account of the old lake terraces of the East African rift valley lakes of Nakuru, Elmenteita, and Naivasha All these lakes would appear to date from the mid Pleistocene period Dr Leakey claims to be able to trace the following sequence of events in Lake Nakuru a high level lake left a terrace at 775 feet above the present level, this fell to 250 feet, rose to 510 feet, and, lastly, fell until it dried up completely Afterwards, in a wetter climate, the waters rose again to 375 feet and then fell, and desiccation again occurred Comparable evidence is obtained from Lake Naivasha and elsewhere in East Africa It shows two major pluvial periods, with oscillations, separated by a dry period, during which faulting and volcanic activity were noteworthy The first and second of these pluvial periods Dr Leakey calls respectively the Makalian and Nakuran periods, and these he correlates with the Buhl and sub Atlantic wet phases of Europe

The Gyromagnetic Effect—The University of California has issued, as a pamphlet of 43 pages, Prof S J Barnett's Research Lecture delivered before the University on "Gyromagnetic Phenomena" When a magnet rotates about its magnetic axis, the gyrostatic action of the electrons brings their planes of rotation towards that of rotation of the material of the magnet and the rotations in the same direction This changes the magnetisation of the magnet, and Prof Barnett used two methods of measuring the change The first depended on the change of the magnetic induction through a coil surrounding the magnet and connected

to a magnetic flux meter; the second on the change of the magnetic field produced by the rotating magnet at a magnetometer needle in its vicinity Both methods gave results which agree in showing that the electricity in motion in a magnetic molecule is negative, and that the gyromagnetic ratio is 1 04 m/e for iron and 1 05 m/e for permalloy, while the theory of the planetary atom predicts 2 m/e Prof Barnett concludes that the electron is a negatively charged sphere spinning about its axis without distortion, which would give the ratio m/e, and that such electrons constitute the chief part of the elementary magnet

Raman Effect for Water—An application of the Raman effect to the study of the composition of water and of its variation with temperature and other conditions is described by I R Rao in the February number of the *Proceedings of the Royal Society* Mercury arc excitation was employed, and the rather broad band which appears with a shift corresponding to about 3μ examined with a microphotometer The explanation offered of the temperature changes is that water consists of single, double, and triple molecules, and that the relative number of the single ones increases with temperature Addition of at least the electrolytes which have been studied also appears to increase the proportion of single molecules, but in this case there is the complication of a new hydrate band superposed on the pre existing water band The explanations of the changes which have been proposed by Dr Rao bear a certain resemblance to those which have been offered for the existence of anomalies in the specific heats of solutions of electrolytes, although no comparison of the two sets of phenomena is presented in this paper

New Measurements of Cosmic Radiation—Some very accurate measurements on the absorption of the cosmic radiation, made with an electroscope containing gas at a pressure of 30 atmospheres, are reported by R A Millikan and G H Cameron in the first February number of the *Physical Review* Their older results have been made more exact for all thicknesses of absorbing material and have also been extended both towards harder and softer components The conclusions drawn are much as before It is concluded, on the basis of the Klein Nishina formula, that there is *quantitative* evidence that the strongest and most easily absorbed cosmic ray band arises from the formation of helium out of hydrogen, and it is considered that there is also good *qualitative* evidence that the three more penetrating bands are due to formation from hydrogen of the oxygen, silicon, and iron groups of elements Prof Millikan and Dr Cameron take the view that some of their results require a participation of the nucleus in the absorption process and refer to some work which has been done upon ordinary gamma radiation as supporting this The point raised is naturally a very important one, as it would imply that the Klein Nishina formula is only approximate, and has also been referred to by Dr L H Gray in a paper in the February number of the *Proceedings of the Royal Society* Dr Gray states that he has experiments now in progress which are designed to reveal any evidence for emission of a secondary radiation from such nuclear interaction

Scattering of X-Rays—An important development in the technique for the examination of scattered X-rays is described in the *Physical Review* for Jan 15, by J W M DuMond and H A Kirkpatrick Two of the main difficulties which arise consist in the exact definition of the angle of scattering, and in obtaining a quantity of scattered radiation which can be recorded by photography in a reasonable time These have been, to a large extent, overcome by the adoption of a new form of multi crystal spectrograph Fifty small perfect crystals of calcite are mounted with Seeman wedges on an arc of a circle, and so arranged that they all reflect a standard line—in this case the $K\alpha$ doublet of molybdenum—to exactly the same point on a photographic film coinciding with an opposite arc of the same circle, the geometry of this arrangement is then such that all other wave lengths and orders will be in focus on the same circle The scattering body is set so that each crystal is protected by a pair of baffles from all radiation except that scattered from a small area, and the X ray bulb, scatterer, and spectrograph arranged so that all the crystals receive only radiation scattered through a range of less than one degree about the mean angle of scattering The troublesome background of general scattered radiation is almost entirely eliminated by the baffles, and the radiation which is scattered without change in wave length appears with excellent definition The radiation which has undergone the Compton change in wave length is, however, definitely spread over a range of wave lengths, the breadth of which increases with increase in angle of scattering This lack of sharpness, although not in complete agreement with the results of earlier investigations, appears to be real, and is ascribed to the fact that the electrons responsible for the scattering have an initial motion in addition to the speed imparted to them in the scattering process

Resolution of *dl* Menthol—Although the naturally occurring l menthol is fairly readily obtained by the resolution of dl menthol, the method does not yield d menthol in quantity Read and Grubb, in the January number of the *Journal of the Chemical Society*, show that a mixture of l menthyl-d camphor 10 sulphonate and the corresponding d menthyl compound, easily obtained by the interaction of dl menthol and d camphor 10 sulphonyl chloride in quinoline, yields the first of these esters in a state of purity after four crystallisations The odour of pure d menthol is fainter than that of l menthol The crystallographic data for d menthol, which can be obtained from ethyl acetate solution in very large, magnificent prisms, are given in the paper

Numerical Solution of Differential Equations—In an extensive memoir (*Bulletin* of the Academy of Sciences of the Ukraine 1930 31, in the Ukraine language), E Remes gives a comprehensive survey of previous work on the numerical solution of differential equations, and contributes some valuable new methods The methods of Runge and of Adams (or, as the Russians say, Adams Stormer) are of great practical value, but they have the defect that they do not indicate exact limits between which the error must lie A method for the determination of such limits was given by Piaggio but in a form unsuitable for practical application Remes has now combined the advantages of both methods The memoir has several worked examples, showing the application to single differential equations and also to systems of such equations The work is complicated, but in cases where great accuracy is desirable, the results justify the labour involved As an alternative to Adams's method, little known formulæ, due to Steffensen Stekloff, are given (Mr Remes and his colleagues at Kieff have sent to University College, Nottingham, a quantity of Russian work on the numerical solution of differential equations, including A N Kryloff's valuable book on this subject, together with manuscript translations or summaries in French or German These may be borrowed for a short period by university librarians)

Electrical Industry and Research

SEVERAL notable developments have taken place in the research laboratories of the Metropolitan Vickers Electrical Co, Ltd, during the past year The investigations on the 'creep' or deformation of metals under stress at high temperatures have led to definite results which are of importance in mechanical engineering It has been proved that even at the lower stresses and temperatures of turbine practice steels cannot be regarded as permanently elastic materials They are subject to gradual stretch or other permanent distortion A quick method of testing steels has been developed in the laboratories, and they can now be placed in order of merit after a duration test of only a few days 'Creep' tests as ordinarily applied may last for months A particular sample was subjected to test for twelve months and was found to creep at the rate of one part in a hundred million per hour For the next two months, however, after the year was completed, it only increased at a tenth of this rate The limit of sensitivity of the apparatus has now been reached, but it is not yet possible to say definitely that creep has ceased If we consider a turbine cylinder 100 inches in diameter and subject to a rate of increase of one part in a hundred million per hour over a period of ten years, its diameter would have increased by nearly one tenth of an inch, and this increase would seriously limit the life of the turbine Other useful mechanical researches are being made in the laboratory as to the effect of surface hardening on the fatigue resistance of gear wheel teeth The results obtained are of great use in designing the best driving gears for electric trams and locomotives

Noise problems are being specially studied in the acoustics laboratory of the Metropolitan Vickers Electrical Co, Ltd The results of this work have been applied in the design of several new sizes of silent type direct current motors These motors have proved specially useful for ship ventilation Good progress has also been made in building alternating current motors that will run quietly

In the high voltage laboratory a comprehensive research has been made on various kinds of dielectric material when subjected to different kinds of stresses, namely ordinary alternating voltages up to a million volts at low frequencies, impulsive voltages, high frequency voltages and steady unidirectional voltages By means of a new cathode ray oscillograph, impulse rushes having definite characteristics can now be applied to the materials The results obtained in this way will be of use in protecting transmission lines and connected apparatus against abnormal voltage rushes These are produced by the steep fronted surges which sometimes arise in the lines and are due either to switching operations or to lightning discharges in the neighbourhood of the line These rushes of electricity are specially serious when they cause resonance effects in the circuit owing to capacitance and inductance An ordinary oscillograph would be useless for studying these phenomena, which last only a few millionths of a second The new cathode ray apparatus developed in the laboratory during two years' research is now in everyday use in conjunction with the million volt lightning generator The rapidity of the response of the oscillograph depends on the great speed of the electron beam, the complete response only taking the two hundred millionth part of a second A reasonable deflection can be obtained with only a few hundred volts

Equally interesting developments in the work of the General Electric Company are recorded in the February issue of the *G E C Journal* Progress in research and technical development is largely independent of trade cycles In a progressive country, the fact that business conditions may be difficult acts more as a stimulant than as a deterrent to scientific advancement Although there has been no epoch making discovery during the last year, yet the total progress made by the G E C compares very favourably even with years containing spectacular achievements

Advances have been made in electric discharge tubes for lighting purposes Neon tubes need no replenishing, as this gas does not disappear appreciably even after running for thousands of hours When pure it gives an orange red colour, but the introduction of a small quantity of mercury makes it a brilliant blue By tinting the glasses and using various mixtures, several new colours have now been introduced A few months ago the 'ripple' type of discharge was discovered The luminous glow in ripple lamps only fills a fraction of the diameter and forms a luminous cord which, instead of remaining stationary along the axis of the lamp, wavers about with a strange but attractive sinuous motion The discharge tubes require high voltages but take very little current A low voltage tube has been invented which operates on low voltages but takes a large current

Improvements have been made in the manufacture of the loading coils used for long telephone cables The cores of these coils are made of a new alloy called 'gecalloy' The manufacture of this alloy involves new methods of making a nickel iron alloy powder Special precautions are necessary to insulate the particles so as to prevent eddy currents By insulating and compressing the iron dust, cores with a permeability lying between 20 and 35 have been obtained One great advantage of these new coils is their small size, as hundreds of coils may need to be installed in a small manhole

A productive research has been made by the G E C Research Laboratories on photo cells as there is a considerable demand for them by the sound film industries A valuable device has been perfected, and is now produced in bulk, for the protection of railway substations from voltage rises It depends for its action on the operation of a neon valve of high current capacity which becomes a conductor at 160 volts It is capable of carrying 3000 amperes for three minutes without undue heating

It is interesting to read that two Diesel electric locomotives were shipped for the Indian State Railways during the past year, and that much development work has been done in connexion with omnibuses operated from overhead trolley wires The most important work was done in connexion with the Manchester Altrincham line electrification This is the first suburban electric railway in Great Britain to be operated at 1500 volts on the direct current system The trial runs have been entirely satisfactory. The electric heating of the coaches from a 1500 volt supply proved to be a difficult problem, as the operation had to be 'mistake proof'

The requirements of the artificial silk industry have led to the production of a motor for driving spinning bowls at 10,000 revolutions per minute This gives a peripheral speed of 3½ miles per minute Enormous lamps, some of them taking 10,000 watts, have been sold to British and Continental cinema studios Very satisfactory progress has been made in the manufacture of oil filled underground cables Three core cables, oil filled, can now be made for 66 kilovolt working

In the article on the mass production of incandescent electric lamps at the G E C factory at North

Wembley, a spirited defence is made of mass production The chief complaint about this method is that the products lack individuality, and hence the inference is sometimes erroneously drawn that they are 'inferior' From the economic and from nearly every other point of view, mass production is the best Unfortunately, there seems little prospect of voltage standardisation—even in Great Britain seven voltages lying between 200 and 260 are in use—and there seems no hope of world agreement Although great efforts have been made to standardise the diffusing 'pearl' finish for the bulbs, many users cling obstinately to the time honoured glare of the unshaded bulb The factory produces no less than 84 different types of product This large number is made necessary by the lack of standardisation in the country

Biological Oxidation

ON Mar 6, Prof H Wieland gave the second Pedler Lecture before the Chemical Society his subject being "Recent Researches on Biological Oxidation" Attempts have been made, he said, to formulate the vital process of combustion according to a single scheme A 'respiratory ferment' catalysing the process is considered by Warburg to be related to hæmin, and Liebig put forward the hypothesis that iron accelerates vital oxidations If we adopt this view, we are faced with the difficulty of understanding why the activated oxygen does not indiscriminately oxidise every substance which the cell presents to it Yet if the process of biological hydrolysis is not carried out by any single ferment system, each kind of substrate being split by its own specific enzyme, it is unlikely that a single catalyst will suffice for the much more complicated process of the oxidative destruction of organic molecules

No fundamental difference is encountered in the nature of enzymes throughout the vast range of living organisms, ascending from unicellular fungi to man, yet we lack the means with which to accomplish the complete degradation, by dead material of a substrate familiar to the cell Hence it would appear that the available enzymatic activity of respiration is closely connected with that regulating principle which, for want of more exact knowledge, we can but describe by a circumlocution called life Since the higher we go up the phylogenetic scale the more delicate and complex becomes the nature of biological oxidation, a preliminary study should be concerned with the aerobic fungi

Prof Wieland discussed the mechanism of the acetic acid fermentation characterising the transformation as a dehydrogenation process, since quinone or methylene blue may replace the oxygen The aerobic process is inhibited by quinone as well as by hydrocyanic acid, the difference being that only the former participates in the enzymic reaction The intermediate formation of hydrogen peroxide as a primary product of biological oxidation is not easy of demonstration, on account of the presence of catalases which cannot, as a rule, be separated from the dehydrases and are also sensitive to hydrocyanic acid The study of milk, however, affords such an opportunity Prof Wieland said that the observation of reducing action in the cell does not necessitate postulation of the existence of special reducing ferments, for reduction products would be formed by the intervention of various hydrogen acceptors in the process of dehydrogenation The enzyme reactions of milk have also contributed to an understanding of catalase action, which appears to be biologically related to the utilisation of oxygen by the cell The two dehydrogenating ferments of milk are clearly of general biological importance, since they have been found also in the liver and other organs

A third enzyme system, found in muscle, is concerned chiefly with the dehydrogenation of succinic to fumaric acid, and both oxygen and methylene blue act as acceptors of the hydrogen This reaction can be followed further biologically to the pyruvic acid stage, and probably even beyond this Pyruvic acid, as a product of the dehydrogenation of lactic acid, is on the main line of biological degradation If we accept enzymic reactions involving hydrogen peroxide, with hydrolysis and condensation, as conditions governing cellular metabolism we facilitate an understanding of the energy changes which constitute the life of the cell

Discussing the correlative oxidation and reduction of aldehydes, Prof Wieland referred to the aldehydrase, which was first described as a reducing enzyme in milk, was later also recognised as an oxidase and is moreover able to dismute aldehydes into acid and alcohol Although the theory that a heavy metal— more particularly iron—takes part in biological oxidations has acquired a certain measure of probability, the recognition of iron as a constituent of oxidising enzymes in no way implies that it functions as an oxygen activator Ferrous iron rather associates itself with the substrate of the oxidation, forming a complex in which the hydrogen atoms to be removed in the dehydrogenation process become labile A clear understanding of the complex course of biological oxidation has, however, not yet been obtained We must advance step by step by the study of such chemically intelligible partial reactions as can be followed accurately

Plantation Rubber Research

THE Annual Report of the Rubber Research Institute of Malaya for 1929 covers the third completed year of active operation, as although the Institute came into existence on Sept 1, 1925, its activities can only be said to date from the appointment of a director in September 1926 The revenue of the Institute is nominally provided by the Governments of the Straits Settlements, Federated Malay States, Johore, Kedah, Kelantan, and Trengganau from a cess on exported rubber, but with the exception of the last, the cess has not been levied, equivalent payments out of revenue having been made Since July 27, 1929, Major B J Eaton has acted as director, an appointment which has recently been confirmed and changes in personnel and shortage of staff hindered the work of the Institute in several directions during the year, notably in the advisory work on behalf of estates A considerable proportion of this advisory work on problems such as manuring, budding, and seed selection, replanting and rejuvenation of rubber areas, is essentially applied research, and useful and valuable results are anticipated Such practical work may indeed require to precede the slower process of scientific development, and the film propaganda among small holders, for which a motor van and apparatus have been approved, should materially help in the development of better conditions on small-holdings

An important division of the Institute is concerned

with soil investigations Our knowledge of and methods of soil investigation are, however, not sufficiently advanced, particularly in connexion with permanent crops such as rubber, to enable recommendations to be made in many cases from the results of a soil analysis alone Short and rapid methods of analysis are being investigated, and valuable information is being obtained as to probable soil deficiencies, particularly in nitrogen and potash, from field observations The problem is specially important in relation to the manuring or rejuvenation of very poor areas of rubber Other work in the same division is concerned with soil conservation and bacteriology, and studies of the relation of soil fungi and bacteria to the soil humus and of the value of leguminous and green cover crops to soil bacteria have been commenced

The botanical division has reported considerable progress in such practical problems as budding, and investigations on the artificial pollination of flowers (from various classes on Pilmoor estate) and on seed selection have continued No new diseases of importance are reported, but the pathological division directs attention to the urgent need for a thorough investigation of the relative value of well known fungicidal chemicals compared with proprietary fungicides Many of the latter are equally effective, and their use is determined chiefly by relative cost A determination not only of the fungicidal properties but also of their penetrative effect on the parts of the plant treated is required Differences in penetrative power affect the toxicity, and this is specially important in regard to bark renewal on the tapping panel The problem of 'mouldy rot' caused by the fungus *Sphaeronema fimbriatum* is one of special interest in regard to fungicidal treatment, which is also important in the case of secondary leaf fall due to the mildew fungus *Oidium Heveæ*, owing to the danger of the fungus becoming more adapted to the host

Investigations at the Institute have thrown new light on the origin and incidence of 'brown bast' Chemical and bacteriological investigations of the production of white sole crepe—the demand for which is regarded as retrograde—the preservation of latex, effects of moulds on rubber and on various factory problems are reported, while considerable progress has been made on the experimental station 905 acres out of the approximately 2000 acres having now been opened 571½ acres of this have been planted and preliminary records of value should be available during 1930 The value of treating young rubber with cattle manure on a particular type of soil has already been demonstrated

University and Educational Intelligence

Cambridge —The Appointments Committee of the Faculty of Physics and Chemistry has appointed Mr P M S Blackett King's College, to be University lecturer in physics, Dr P J Durrant, of Selwyn College, and Dr F P Bowden, of Gonville and Caius College to be University demonstrators in chemistry

The General Board has recommended that a readership and a University demonstratorship in geophysics be established in the Faculty of Mathematics, and that Dr H Jeffreys, of St John's College, be appointed reader

Dr J Wishart has been appointed University lecturer in statistics in succession to Mr G Udny Yule, who has been appointed reader in statistics

The Sedgwick Prize for 1931, for an essay on geology, has been awarded to Dr C E Tilley, of Emmanuel College

London —The following doctorates have been awarded *D Sc in Chemistry* to Mr A M Ward, Birkbeck College for a thesis entitled "Investigations on the Bivalency of Carbon", consisting of four published papers (*Jour Chem Soc*, 1927, 1929, 1930), *D Sc in Physics* to Mr S H Piper, King's College, for a thesis entitled "X ray Studies of Long chain Compounds", comprising three published papers (*Jour Chem Soc*, 1929, *Trans Far Soc*, 1929, and *Proc Roy Soc*, A, 1930), *D.Sc in Entomology* to Mr W J Hall, Imperial College—Royal College of Science, for a thesis entitled "The South African Citrus Thrips in Southern Rhodesia" and "Observations on the Coccidæ of Southern Rhodesia", parts 1 3, and eight subsidiary contributions, *D Sc in Geology* to Dr A Brammall for a thesis entitled "Gold and Silver in the Dartmoor Granite" (*Min Mag*, vol 21, 1926), "The Dartmoor Granite" (*Proc Geol Assoc*, vol 27, 1926), "Dartmoor Detritals—A Study in Provenance" (*Proc Geol Assoc*, vol 39, 1928), "Notes on Fissure Phenomena and Lode-Trend on Dartmoor" (*Trans Roy Geol Soc of Cornwall*, vol 16, 1928), and eight subsidiary contributions

During the seventh year of the Ella Sachs Plotz Foundation for the advancement of scientific investigation, seventy eight applications for grants were received by the trustees, sixty two of which came from twelve different countries in Europe and Asia, the remaining sixteen coming from the United States The total number of grants made during this year was twenty five, one of these being a continued annual grant Twenty one of the new grants were made to scientific workers in countries outside the United States In the seven years of its existence, the Foundation has made one hundred and twenty grants and investigators have been aided in the United States, Great Britain, France, Germany, Austria, Hungary, Switzerland, Italy Sweden, Esthonia, Czechoslovakia, Poland, Chile, Syria, and Belgium Applications for grants to be held during the year 1931–32, to be sent to Dr Joseph C Aub, Collis P Huntington Memorial Hospital 695 Huntington Avenue, Boston, Massachusetts, should be in the hands of the Executive Committee before May 1, 1931

The Carnegie Trust for the Universities of Scotland has allocated, as grants for the quinquennium ending September 1935 for universities and extra mural institutions respectively, £224,700 and £34 325 Since the Trust's operations began in 1902, the total grants have been distributed as follows for libraries, £159,850, buildings and permanent equipment, £905,101, endowment of chairs, lectureships, and pension schemes, etc, £437,701, other purposes, £143 730 A noticeable feature of the last quinquennial allocation is the assistance towards such student purposes as residential halls, students' unions, and playing fields, which have always specially appealed to the Trust Assistance to students in payment of class fees for 1929-30, accounting for nearly half of the Trust's expenditure, amounted to £56,316, distributed among 4531 beneficiaries Voluntary repayments by 54 former beneficiaries (21 men and 33 women) amounted during the same year to £2036 Apart from the quinquennial grants scheme and assistance to students, the Trust spent last year on fellowships, scholarships, and other grants for the endowment of research, £19,516 Under its research scheme the Trust recently instituted senior scholarships, of the annual value of £200, to provide, in particular, for the Ph D candidate, who must generally be engaged for three years at post graduate work before he presents his thesis for that degree

Birthdays and Research Centres.

Mar 15.—Prof C V BOYS, F R S, past president of the Physical Society of London

In NATURE of July 13, 1929, p 54, I gave a diagram of a more powerful camera for observing the progressive movement of lightning Since then I have had one of these cameras made by Messrs Ross, Ltd I have not been able to try this on real lightning, but last spring Mr Goodlet, late of the Metropolitan Vickers Electrical Co, Ltd, allowed me to photograph their high tension sparks I never expected that I should be able to observe any 'progress' in this artificial lightning five feet long only, but running the film at approximately 100 miles an hour I obtained sharp rather over exposed images With Tesla sparks the photographs show perfectly sharp but very pale images of extraordinary tenuity The real object of the experiment was to prove the satisfactory running of the instrument and its optical perfection In these respects it could not be improved upon I sent this to Mr Loomis, and he and Prof R W Wood have had it for the greater part of one summer, but they have so far not succeeded in catching anything However, I succeeded in obtaining a photograph during the great storm on Aug 29 last with my original camera, but only when the lightning was too close Moreover, the two flashes caught were very much to one side and the nearer one had the greater part of one image off the plate altogether The other pair of images gives some stereoscopic indication of progress, but it must be remembered that the longer the image on the plate the less conspicuous will this be For this reason it is desirable that lightning should not be nearer than five or six miles The short focus lenses in the new camera and the higher speed attainable make this instrument ten or more times as powerful as the original camera which I made in 1900 As I had to wait twenty eight years before obtaining my first picture, which was taken in America (see NATURE, Nov 20, 1926, p 749), and got only a useless one last year, it would seem desirable that more than one of the new cameras should be available in suitable observatories, for information as to the progress of a lightning flash can be obtained in no other way, and any information so obtained is unassailable

Mar 17, 1876.—Dr F J W WHIPPLE, superintendent of Kew Observatory

The principal subject of investigation at Kew Observatory at present is the circulation of atmospheric electricity In fine weather, there is a continuous, though small, current of positive electricity from the air to the ground, in disturbed weather, currents in the reverse direction are the more frequent There is much to learn about these currents and their relation to other atmospheric conditions, such as potential gradient, dust content, ionisation, conductivity, and radioactivity

My own attention has recently been given to questions raised by the observations of the propagation of air waves to great distances, and especially by the numerous observations which have been made during the last four years of the air-waves from gunfire It is hoped to obtain from such observations reliable information as to the variations in the temperature of the atmosphere at heights of 40 km and upwards, where the absorption of ultra-violet light by ozone heats up the air

Mar 19, 1871.—Prof WILLIAM ARTHUR BONE, F R S, professor of chemical technology in the Imperial College of Science and Technology

At present I am working on (1) The chemical constitution of coals, as a problem in organic chemistry, with the object of ascertaining the essential molecular structure of the coal substance, its relation to the lignins, etc, from which it originated, the chemical aspects of its maturing, and the development of the coking propensities of bituminous coal (2) Gaseous combustion and explosions, more particularly (a) the slow combustion of hydrocarbons, (b) the function of steam in the combustion of carbonic oxide, (c) the photographic analysis of 'detonation' in gaseous explosions, and (d) gaseous explosions at very high initial pressures, for example, between 500 and 1000 atoms (3) Catalytic gas reactions at high pressures (4) The chemical reactions involved in the blast furnace smelting of iron ores, with the view of providing a fundamental basis for fuel economy and control in this operation

I believe that the proper function of university departments of applied science is to carry out systematic researches of a fundamental character into general problems underlying industrial practice, rather than investigations of particular works' problems, which can best be tackled by industrial research organisations

Societies and Academies

LONDON

Royal Society, March 5.—**W L Garstang** and **C N Hinshelwood** The kinetics of the combination of hydrogen and oxygen the influence of iodine *The surface reaction in vessels of silica and porcelain* is accelerated by iodine The amounts of iodine required are small The efficiency of collisions with iodine in breaking chains is, however, less than about 10^{-4} Water vapour lowers the upper critical limit of the low pressure explosion region and in sufficient amount, inhibits the explosion altogether Commercial hydrogen appears to contain no inhibiting substances —**D R Hartree** Optical and equivalent paths in a stratified medium, treated from a wave standpoint Wave treatment is essential for the interpretation of some of the phenomena of reflection from the Heaviside layer Expressions for the optical and equivalent paths in terms of the solutions of the equations of wave propagation are obtained, both for normal and oblique incidence, and exact expressions are obtained for the optical path for normal incidence on stratified media with certain simple variations of refractive index Approximate expressions are obtained for the optical and equivalent paths in a totally reflecting medium —**H J Phelps** The adsorption of substances by fuller's earth The adsorption of weak solutions of various organic acids and bases has been studied, in particular, attention is directed to a study of the adsorption of such substances from solutions of various hydrogen-ion concentrations The adsorption of the simple amines is molecular, or 'apolar', in solutions of reaction more alkaline than pH 9, while it is ionic, or 'polar', in solutions more acid than about pH 8 The adsorption of bases and also of oxalic acid falls to zero in solutions more acid than pH 3, due to the fact that the calcium salts in fuller's earth, the presence of which is essential for adsorption to take place, are soluble under these conditions —**L J Mordell** The arithmetically reduced indefinite quadratic form in n variables A simple method is given for finding inequalities satisfied by the coefficients of a reduced indefinite form When the coefficients are integers a simple proof is given that the class number for forms with given determinant is finite A normal type is also found for the reduced forms —**A E Moelwyn Hughes** and **C N Hinshelwood** The kinetics of reactions in solution (1, 2) The decom-

position of chlorine monoxide in carbon tetrachloride solution proceeds at the same rate, possesses the same heat of activation, and apparently takes place by the same mechanism as in the gaseous state The retardation of bimolecular reactions by solvents thus appears to depend upon a specific influence of particular solvents, and need not occur in an 'ideal' solution The aim of the experiments was to determine whether constancy of rate and heat of activation with change of solvent can be regarded as the usual characteristic of a unimolecular reaction It is concluded that it is only true of certain 'ideal' solvents —**F R Terroux** The upper limit of energy in the spectrum of radium *E* The velocities of the fastest β rays from radium *E* were determined from the curvature of the tracks in a magnetic field and the distribution of the rays obtained in the region extending from 4000 to 10 000 $H\rho$ The complete spectrum of radium *E* was obtained by combining the present observations with previous work and the resulting curve shows no trace of the hitherto accepted end point at about 5000 $H\rho$ The spectrum appears to tail off very gradually and to extend at least to 12,000 $H\rho$, which corresponds to an energy of 3,000 000 electron volts The number of particles above 5000 $H\rho$ is about 4 per cent of the total number emitted An energy distribution curve was obtained, and from this the average energy per disintegration is estimated at about 473,000 volts, with a probable error of 20 per cent which is in fair agreement with the values obtained from heating measurements It appears probable that the β particles from radium *E* are emitted from the nuclei according to a simple distribution law which resembles the Maxwellian form and that there is a finite probability for the emission of a particle with any velocity —**K R Rao** and **J S Badami** Investigations on the spectrum of selenium—(1) The spectrum of selenium has been investigated from λ7000 to λ650, mainly using different intensities of discharge through capillary tubes containing vapour of selenium Between λ1400 and λ400 vacuum spark spectra have been taken with and without inductance With the aid of these data the doublet system of trebly ionised selenium has been identified A few singlets and inter combination lines in Se V have been added to the triplet system that was already known The largest term, $4s\ ^1S_0$ is found to be 589,781 cm^{-1}, leading to an approximate ionisation potential of 72 8 volts —**J K L Macdonald** Stark effect in molecular hydrogen in the range 4100 4770 A Certain complex structures reported by Kiuti are resolved into independent lines Displacements of line components are measured and the observations are considered from a theoretical point of view Certain groups of *P* and *R* branch lines with common initial levels are found to be adequately described, as regards number and polarisation of components, by a theory which is briefly discussed —**T Alty** The reflection of vapour molecules at a liquid surface The rate of evaporation from a water surface is measured as a function of the vapour pressure above the evaporating surface By extrapolation to zero pressure the rate of evaporation into a vacuum is found On comparing this experimental result with the formula of the kinetic theory of gases for the number of vapour molecules striking a water surface per second from the saturated vapour, it appears that only about 1 per cent of the molecules incident on the surface are able to enter the liquid

PARIS

Academy of Sciences, Jan 19 —**H Douvillé** The eruptive rocks of the Pic de Rébenacq —**André Blondel** The improvement of the present system of electromagnetic units If the units of E M F and current are taken as 10 volts and 10 amperes and the power unit as the hectowatt, leaving the ohm and the farad unchanged, then such a system contains only 10^9 and 10^{-9} in all its elements In the C G S system the new prefixes 'nea' for 10^9 and 'cato' for 10^{-9} are suggested The deficiencies of the present system of nomenclature are fully discussed —**C de la Vallée Poussin** The conformal representation of multiply connexe plane areas —**W Vernadsky** Isotopes and living organisms A discussion of the possibility of living organisms possessing the property of separating isotopes, in the course of their life —Richard Fosse was elected a member of the Section of Rural Economy in succession to the late A Th Schloesing, and Eugene Fabry *correspondant* for the Section of Geometry in succession to the late M Riquier —**A Norden** The inclusion of the metric and affine theories of surfaces in the geometry of specific systems —**Rachevsky** Congruences with several dimensions —**G Gourewitch** The divisibility of trivectors and quadrivectors by a vector **Mlle Marie Charpentier** A certain class of Peano points —**Basile Demtchenko** A mixed problem in the ring —**Raphael Salem** The necessary and sufficient conditions that arbitrary constants a_n, b_n should be Fourier coefficients of a function capable of summation —**Emile Belot** The origin and formation of Pluto according to the dualist cosmogony —**Gr C Moisil** Wave mechanics of fields of waves —**L Brüninghaus** The electrical conduction of liquid hydrocarbons in thin layers A drop of fresh vaseline oil, inserted between two electrodes 11 μ apart, closes a 110 volt continuous circuit "as if it were a drop of mercury" This conducting state is abolished when the electrodes are 15 μ apart —**J M Cork** Change of wave length of the X rays traversing an absorbing medium (observed in the direction of transmission) An attempt to repeat some experiments recently described by B B Ray (NATURE, 125, p 856) has given only negative results possibly due to the different screens employed —**J Dourgnon** and **P Waguet** Remarks on certain photometric properties of ground and grained glass —**J P Mathieu** A method of measuring circular dichroism **Jean Loiseleur** and **Léon Velluz** The association of biochemical constituents and certain cellulose esters Details of technique for preparing membranes containing cellulose acetate and casein or other proteins —**A Travers** and **J Aubert** The potential of passive iron From the results of the experiments described, it is concluded that the term 'passive iron' has no absolute meaning, there are degrees of passivity The film of oxide theory of passivation cannot apply in all cases, since the potential of iron immersed in different oxidising agents depends on the nature of the latter —**André Michel** and **Pierre Benazet** The reheating of rapidly tempered steels —**P Brauman** The alkyl oxyvanadylsalicylates of alkyls and aryls —**Raymond Furon** The geology of the Gabon (French Equatorial Africa) —**R Bureau** A recording radiogoniometer Its application to atmospherics Ranzi's neon lamp method has been modified to record not only the variations of the atmospherics but also their direction Two diagrams are reproduced —**Louis Dangeard** The lower algæ in the Limagne limestone —**Jules Amar** Hydrodiffusion and deadly fogs —**Pierre Lavialle** The stamen in *Knautia arvensis* The polymorphism of the flowers and flower heads —**Emile Saillard** The precipitation of lime by sulphurous acid in sugar solutions —**Ph Joyet-Lavergne** The conditions of metabolism permitting the realisation of the change of sex —**Georges Blanc** and **Jean Valtis** The sensibility of *Spermophilus citillus* to experimental tuberculous infection —**F Dienert** and **P Etrillard** The sterilisation of water by metals

Official Publications Received.

BRITISH

The Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, Nova Scotia Vol 17, Part 4, Session 1929-1930 Pp. xxxiii liii+213 275+xvii (Halifax, N S) 50 cents

Indian Central Cotton Committee Technological Laboratory Technological Bulletin, Series B, No 11 Random and Systematic Selections of Warp Specimens in Cloth Sampling By Dr A James Turner Pp 21 (Bombay) 8 annas

Department of Scientific and Industrial Research Building Science Abstracts Vol 3 (New Series), No 12 December 1930 Abstracts Nos 2183 2377 Pp 411 531 (London H M Stationery Office) 9d. net

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 6, No 1 January Pp 132 (Cambridge At the University Press) 12s 6d net

Southern Whaling Presidential Address delivered at the Anniversary Meeting of the Linnean Society of London on the 24th of May 1930 By Sir Sidney F Harmer Pp 85 168 (London Linnean Society)

A List of International Fellowships for Research (Pamphlet No 4) Pp 228 (London The International Federation of University Women) 1s

The Indian Forest Records Botany Series Vol 16 Part 1 Illustrations of Indian Forest Plants Part 2 Five Species of Dipterocarpus By R N Parker Pp. ii+16+10 plates (Calcutta Government of India Central Publication Branch) 1 rupee 1s 9d

The Hannah Dairy Research Institute Bulletin No 2 Reactors in Tuberculin Tested (Licensed) Herds By Alexander B Fowler and Dr Norman C Wright. Pp 51 (Auchincruive)

Empire Cotton Growing Corporation Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on February 5th, 1931 Pp 7 (London)

FOREIGN

Library of Congress Report of the Librarian of Congress for the Fiscal Year ending June 30 1930 Pp vi+420+12 plates (Washington D C Government Printing Office)

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science Special Bulletin No 204 Investigations of Corn Borer Control at Monroe Michigan By A R Marston and C B Dibble Pp 47 Technical Bulletin No 108 Influence of Soil Conditions Fertilizer Treatments and Light Intensity on Growth, Chemical Composition and Enzymic Activities of Sugar Beets By James Tyson Pp 44 (East Lansing Mich)

Mémoires du Musée Royal d Histoire Naturelle de Belgique Mémoire No 43 Mollusques des couches à Cyrenes (paléocène du Limbourg) Par Dr Émile Vincent Pp 43+8 planches Mémoire No 45 Hydromedusae collected in the South Western Part of the North Sea and in the Eastern Part of the Channel in 1903-1914 By P L Kramp Pp 55 Mémoire No 46 Études sur les mollusques Montiens du Poudingue et du *Tuffeau de Ciply* Par Dr *Emile Vincent.* Pp 115+6 planches (Bruxelles)

United States Department of the Interior Geological Survey Bulletin 813 D Notes on the Geology of Upper Nizina River, Alaska By Fred H Moffit (Mineral Resources of Alaska 1928) Pp ii+143 166+plate 3 15 cents Bulletin 817 Boundaries Areas Geographic Centers and Altitudes of the United States and the several States with a Brief Record of Important Changes in their Territory and Government By Edward M Douglas Second edition Pp vii+265+12 plates 50 cents Bulletin 821 A A Graphic History of Metal Mining in Idaho By Clyde P Ross (Contributions to Economic Geology 1930 Part 1) Pp ii+9+3 plates 10 cents Bulletin 822 C Bituminous Sandstone near Vernal Utah By E. M Spieker (Contributions to Economic Geology, 1930 Part 2) Pp ii+77 100+plates 7 9 10 cents Bulletin 824 A Mineral Industry of Alaska in 1929, and Administrative Report By Philip S Smith (Mineral Resources of Alaska 1929) Pp ii+109 20 cents (Washington, D C Government Printing Office)

CATALOGUES.

A Catalogue of Important and Rare Books on Botany, Agriculture, Forestry Fruit Culture, Gardens and Gardening Herbals, Early Medicine and Surgery Tobacco Original Water Colour Drawings by Ehret and Van Huysum and an Important Collection of Pamphlets (No 443) Pp 148 (London Bernard Quaritch, Ltd)

Useful Gardening Books Pp 8 List of Gardening and Botanical Books including Materia Medica, Pharmacy, Perfumery and Scent etc (No 183) Pp 20 (London Dulau and Co, Ltd)

Taylors Bee Supplies. Pp 44 (Welwyn E H Taylor Ltd)

Diary of Societies

FRIDAY, MARCH 13

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Scottish District Meeting) (at City Chambers Edinburgh), at 11 30 A M —W B Scott The Proposed National Standard Practice for the Employment of Structural Steel in *Building*, as Delegated by the *British Steel Work* Association

BIOCHEMICAL SOCIETY (Annual General Meeting) (at University College), at 3.—Prof C Lovatt Evans, Chiao Tsai, and F G Young A Note on the Estimation of Liver Glycogen —R A McCance and H L Shipp The Colorimetric Determination of Sodium —E Stedman and Ellen Stedman Studies on the Relationship between Chemical Constitution and Physiological Action Part III The Inhibitory Action of Certain Synthetic Urethanes on the Activity of Liver Esterase — B C J Knight An Electrolytic Method for Poising the Oxidation reduction Potential of Culture Media.—G F Marrian Observations on the Physiological Potency of Crystalline Tri hydroxy Œstrin — Prof T P Hilditch and J J Sleightholme The Glyceride Structure of Butter Fats.—H R Ing and R N Kekwick A Note on Acyl Derivatives of Creatine and Creatinine.—I S MacLean and M S B Pearce Oxidations of Oleic Acid *in vitro* and their Bearing on the Biological Oxidation of Oleic Acid —C Rimington and A M Stewart A Pigment from the Suint (Sweat Fraction) of Raw Sheep s Wool

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30 —Dr H H Mann The Tea Industry of India in its Scientific Aspects

ROYAL ASTRONOMICAL SOCIETY at 5 —Sir A S. Eddington A Theorem concerning Incomplete Polytropes J Young Occultations of Stars by the Moon observed at Birmingham University during 1930 —T Matukuma Relativity Effect in the Problem of Latitude Variation —J Dufay Effect of Atmospheric Absorption in Stellar Spectrophotometry J H Hindle A New Test for Cassegrain and Gregorian Secondary Mirrors —V V Narliker The Significance of Bode s Law in Relation to Satellite Systems —L H Thomas The Slow Contraction and Expansion of a Fluid Sphere II Stability —S Chandrasekhar The Dissociation Formula According to the Relativistic Statistics —C S Beals Wave Lengths of Oxygen and Nitrogen Lines in the Stellar Region Royal Observatory Greenwich Observations of Solar Flocculi made with the Spectrohelioscope during 1930 — Dr H H Plaskett The Formation of the Magnesium *b* Lines in the Solar Atmosphere —B Strömgren The Possible Solutions of the Equations of Fit on the Standard Model T G Cowling Note on the Fitting of Polytrope Models in the Theory of Stellar Structure — S Chandrasekhar The Highly Collapsed Configurations of a Stellar Mass

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Middlesex Hospital) at 5 —Clinical Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Demonstration of Specimens illustrating the Anatomy Physiology, and Pathology of the Œsophagus

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society) at 6 —H H Bloomer On the Anatomy of *Bruguiera* cf *aneyi*, Bourguignat — J R le B Tomlin Two New Species of *Ishiostoma* —C Oldham Some Scalariform Examples of *Helicella arbustorum*

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle upon Tyne) at 6 —S F Dorey Some Factors Influencing the Sizes of Crankshafts for Double Acting Diesel Engines

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) at 6 15 —C J F Tweed Aspects of the Transmission and Reception of Still Pictures

INSTITUTE OF FUEL (North Western Section) (at Engineers Club Manchester) at 7 —Dr G E K Blythe The Industrial Application of Pulverised Fuel

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at Literary and Philosophical Society Manchester) at 7 —Dr E G Ritchie Steam Storage in Relation to the Locomotive

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 —Dr F A Mason Recent Lines of Advance in Lake and Pigment Chemistry

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —L Clegg Phenol Formaldehyde Moulding Compositions Manufacture and Use

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society) at 8 —W J Rees The Manufacture of Lime

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —J C Squire Parody

SATURDAY, MARCH 14

INTERNATIONAL SOCIETY OF LEATHER TRADES CHEMISTS (British Section) (at University Leeds) at 10 A M —R F Innes Determination of Water in Vegetable Tanned Leather —Dr A C Russ New and Improved Method of Moisture Determination and its Application to Leather —Dr D Burton Note on the Determination of Moisture in Leather —H G Bennett and others Discussion on Mineral Acids in Vegetable Leather —Demonstration of a New Form of Tintometer, by Dr J G Parker

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Lord Rutherford Recent Researches on the Alpha Rays (2)

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute) at 3 30 —R. Sedgwick A Brief Restatement of the Case for Psychological Hedonism and an Examination of some Fundamental Concepts in Affective Psychology

MONDAY MARCH 16

VICTORIA INSTITUTE (at Central Buildings, Westminster) at 4 30 —Col F C Molesworth History of Practical Astronomy

ROYAL GEOGRAPHICAL SOCIETY at 5 —W V Lewis The Effect of Wave Incidence on the Configuration of a Coast

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —C E Shattock Demonstration of Specimens illustrating Affections of the Kidney

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section), at 6 45 — C Day Heavy Oil and Diesel Engines (Lecture)

SOCIETY OF CHEMICAL INDUSTRY (Edinburgh and East of Scotland Section) (Annual General Meeting) (at 36 York Place Edinburgh) at 7 —Dr H Hepworth Invention in Chemical Industry

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —Dr A Rosen and others Discussion on Some Difficulties in A C Bridge *Measurements*

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7

INSTITUTION OF ELECTRICAL ENGINEERS (Tees Side Sub Centre) (at Cleveland Technical Institute Middlesbrough), at 7 —B Leggett The Medical and Surgical Applications of Electricity

SHIPLEY TEXTILE SOCIETY (at Technical School Shipley) at 7 30 —Prof Barker South Africa its Sheep and Wool (Lecture)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —C R. Peers The Treatment of Old Buildings.

ROYAL SOCIETY OF ARTS, at 8.—Capt. A. G. D. West: The Recording and Reproducing of Sound (Cantor Lectures) (2).
EUGENICS SOCIETY (at 20 Grosvenor Gardens, S.W.1), at 8.15.—Study Circle.

TUESDAY, MARCH 17.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. M. Critchley: The Neurology of Old Age (Goulstonian Lectures) (3).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Darlington: The Cytological Theory of Heredity and Variation (2).
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
MINERALOGICAL SOCIETY, at 5.30.—A. J. P. Martin: On a New Method of Detecting Pyro-electricity.—Dr. D. R. Grantham and F. Oates: On the Mbosi Meteoric Iron, Tanganyika Territory.—Dr. S. R. Nockolds: On the Dhoon (Isle of Man) Granite: a Study of Contamination.—A. G. MacGregor: On Clouded Felspars as a Result of Thermal Metamorphism.—C. N. Fenner: On the Residual Liquids of Crystallising Magmas.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. R. Broom: On the *Pygocephalus*-like Crustacean of the South African Dwyka.—Dr. P. R. Lowe: On the Anatomy of *Pseudocalyptomena* and the Occurrence of Broadbills (Eurylaimidæ) in Africa.—J. St. Leger: A Key to the Families and Genera of African Rodentia.—B. W. Tucker: (*a*) Note on a Skull of *Sus gargantua* Miller, in the Cambridge Museum; (*b*) On the Occurrence of *Rana græca* at Small Altitudes in the Naples District, with some Observations on Habits.
INSTITUTE OF METALS (Birmingham Section) (in Chamber of Commerce, Birmingham), at 7.—Dr. C. J. Smithells: The Metallurgy of Some of the Rarer Metals.
ROYAL SOCIETY OF MEDICINE (Pathological Section) (Annual General Meeting), at 8.

WEDNESDAY, MARCH 18.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. B. R. King: A Fossiliferous Limestone Associated with Ingletonian Beds at Horton-in-Ribblesdale, Yorkshire.—Prof. O. H. Schindewolf: On the Septal Development and the Genotype of the Coral Genus *Zetraia* Münster.
ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—Dr. W. E. Cooke and C. F. Hill: Microscopical Studies in Pernicious Anæmia. (3) The Macropolycyte. (4) Nuclear Degeneration in Blood Stream Cells.—F. G. Wood: Micro-polarising Crystals and their Projection.
NEWCOMEN SOCIETY (at Caxton Hall), at 5.30.—J. G. H. Warren: John Nuttall's Sketch Book and Notes on Wrought Iron Detail for Early Locomotives.
OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—W. C. Baxon and others: Discussion on Overhead Line Difficulties.
LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—G. S. Baker: Horse-power of Ships as Affected by Rudders and Propellers.—R. F. Leggat: Notes on Water-Power Development in Canada.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—W. Redmayne: Cable Fault Localisation by Telephone Methods.
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Botany and Biology Section) (jointly with Leicester Branch of British Empire Naturalists' Association) (at Leicester Museum), at 7.30.—Mr. Bastard: Why is there no Darwinian Morality?
ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Commander E. C. Shankland: Navigation from Viking Period to Present Day in Relation to Science and Meteorology (G. J. Symons Memorial Lecture).
FOLK-LORE SOCIETY (at University College), at 8.—A. M. Hocart: Caste in Fiji.
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (in College of Technology, Leicester), at 8.—Dr. G. Lawton: Some Metallurgical Problems in the Electrical Industry.
ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—A. W. Hothersall: Some Investigations in Copper Deposition.
ROYAL SOCIETY OF ARTS, at 8.30.—Lt.-Gen. Sir William Furse: Some Aspects of Inter-Imperial Trade (Trueman Wood Lecture).
SOCIETY OF GLASS TECHNOLOGY (at Stourbridge).

THURSDAY, MARCH 19.

LINNEAN SOCIETY OF LONDON, at 5.—Prof. J. Stanley Gardiner: Photosynthesis and Solution in the Building of Atolls.—Dr. Max Bernhauer and Dr. H. Scott: Coleoptera, Staphylinidæ of Abyssinia.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir William Willcox: Toxic Jaundice (Lumleian Lectures) (1).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: Respiration (3).
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss Marion Richardson: Children's Drawings.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. W. Hoff: Research in the Berlin Technische Hochschule.
ILLUMINATING ENGINEERING SOCIETY (at Institution of Electrical Engineers), at 7.—H. T. Young: Modern Domestic Lighting.
INSTITUTE OF RUBBER RESEARCH (at "Manchester Ltd.", Manchester), at 7.—S. A. Brazier: Some Problems in Sponge Rubber Manufacture.
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (Annual Meeting) (at University, Bristol), at 7.30.—Chairman's Address.
CHEMICAL SOCIETY, at 8.—F. M. Rowe and A. T. Peters: A New Reaction of Certain Diazosulphonates Derived from β-naphthol-1-sulphonic Acid. Part IV. The Constitution of the Condensation Products of Diazo-compounds with β-naphthol Derivatives Substituted in the 1-position.—F. M. Rowe, Miss E. Levin and A. T. Peters: A New Reaction of Certain Diazosulphonates Derived from β-naphthol-1-sulphonic Acid. Part V. The 4-nitro- and 4′-amino-derivatives of 4-methyl-3-phenylphthalaz-1-one.—F. M. Rowe and C. Dunbar: A New Reaction of Certain Diazosulphonates Derived from β-naphthol-1-sulphonic Acid. Part VI. Preparation of Phthalazine, Phthalazone and Phthalimidine Derivatives from 2:6-dichloro-4-nitroaniline.—F. M. Rowe and N. H. Williams: A New Reaction of Certain Diazosulphonates Derived from β-naphthol-1-sulphonic Acid. Part VII. Preparation of Phthalazine, Phthalazone and Phthalimidine Derivatives from 2:6-dibromo-4-nitroaniline.—K. N. Menon and R. Robinson: Strychnine and Brucine. Part XII. The Constitution of Dinitrostrycholcarboxilic Acid.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Royal Army Medical College, Grosvenor Road, S.W.), at 8.15.—Laboratory Meeting.
HARVEIAN SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.30.—Sir Percy Sargent: The Romance of the Pituitary Gland.
BRITISH INSTITUTE OF RADIOLOGY (at 32 Welbeck Street), at 8.30.

FRIDAY, MARCH 20.

PHYSICAL SOCIETY (at Imperial College of Science) (Annual General Meeting), at 5.—Presentation of Duddell Medal, 1930, to Sir J. Ambrose Fleming.
ROYAL SANITARY INSTITUTE (at Technical College, Lincoln), at 5.—L. O. Need and others: Discussion on Houseboats on Inland Waterways.—S. C. Baggott and others: Discussion on Refuse Collection and Disposal.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of the Anatomy and Nerve Supply of the Diaphragm.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—R. S. Allen and W. E. W. Millington: Modern Methods of raising Water from Underground Sources.
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—T. Millican: Corrosion with Reference to Boilers.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (Informal Meeting), at 6.30.—W. Lawson and others: Discussion on Should the Bottom Bearings of Meters be Oiled?—W. Holmes and others: Discussion on Are Cobalt Steel Magnets Desirable for Use as Permanent Magnets for Instruments?—Lt.-Col. K. Edgcumbe and F. Hope-Jones: Discussion on Are Synchronous Motors or Clocks More Suitable for Time Service?—J. W. Record and W. Phillips: Discussion on Are Long Scales Preferable to Short in Indicating Instruments?
INSTITUTE OF CHEMISTRY (Manchester Section) (Annual General Meeting) (at "Manchester Ltd.", Manchester), at 7.—Prof. R. M. Caven: Lecture.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Informal Discussion.
INSTITUTION OF MECHANICAL ENGINEERS (jointly with Institution of Automobile Engineers) (at Merchant Venturers' Technical College, Bristol), at 7.—Dr. J. S. Davies: An Experimental Investigation into Induction Conditions, Distribution and Turbulence in Petrol Engines.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—H. W. Howes: Pyrex Glass, its Properties and Application.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. S. Roberts: Some Token Systems of Railway Signalling.
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. Chalmers Watson: Radiation in Relation to Human and Animal Life.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. N. da C. Andrade: Sound, Sand, and Smoke: New Light on Old Problems.
GEOLOGISTS' ASSOCIATION (North-East Lancashire Group) (at Technical College, Blackburn).—J. Ranson: The Structure of the Alps (Lecture).

SATURDAY, MARCH 21.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire and North Western Districts) (at College of Technology, Manchester), at 2.30.—Dorman Long and Co., Ltd.: The Building of the New Tyne Bridge; The Building of Imperial Chemical House; and The Sydney Harbour Bridge.
MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—S. Inman: Contracted Methods in Arithmetic.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford: Recent Researches on the Alpha Rays (3).

PUBLIC LECTURES.

FRIDAY, MARCH 13.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 8.—Prof. E. Mellanby: Diet and Health (Sir Charles Hastings Lecture).

SATURDAY, MARCH 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Augustan Age.

MONDAY, MARCH 16.

KING'S COLLEGE, LONDON, at 5.30.—Prof. K. S. Lashley: Problems in the Physiology of Behaviour. (Succeeding Lectures on Mar. 18 and 19.)
UNIVERSITY COLLEGE, at 5.30.—Prof. B. Brouwer: The Central Nervous System. (Succeeding Lecture on Mar. 17.)

TUESDAY, MARCH 17.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15.—Dr. C. H. Andrewes: Immunity in Virus Diseases (1).

WEDNESDAY, MARCH 18.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Lt.-Col. G. E. F. Stammers: Tropical Hygiene for Men and Women proceeding to the Tropics. (Succeeding lectures until Mar. 27.)
KING'S COLLEGE, LONDON, at 5.30.—Dr. V. T. Harlow: The Great Age of Discovery: The Search for El Dorado.

FRIDAY, MARCH 20.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at Chartered Surveyors' Institution), at 5.30.—C. S. Wright: The Scientific Purposes of Antarctic Exploration.

SATURDAY, MARCH 21.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Peasant Life in Alpine Districts.

SATURDAY, MARCH 21, 1931

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The Study of British Archæology

ARCHÆOLOGICAL studies, like many other things, have changed greatly since the War. They have now passed definitely and finally from the province of the antiquarian and the dilettante. In Great Britain, science, at least in certain of its branches, has always been the playground of the amateur; and archæology perhaps more than any other of these studies, except perhaps astronomy, owes much to his efforts. But long before the War it had been made evident that archæological exploration demanded more than merely the opportunity and the means—for digging is an expensive business—to open up a burial mound or a prehistoric settlement. It needs but a glance through the pages of an archæological publication with a long run, such as *Archæologia*, for the last thirty or forty years, to appreciate the vast amount of excellent work that has been done in Great Britain on thoroughly sound lines by men who were scientific in method if in status they were amateur.

Excellent as this work was, too often its outlook was restricted and its interest confined to one aspect or to one type of problem. To-day, it may seem scarcely credible that in the last decade of the nineteenth century the British Association appointed a committee to ensure the record and preservation of objects not of Roman or Romano-British origin found in the excavation of Romano-British sites in Britain. In spite of the interest that has been taken in Roman antiquities in Britain—an interest which has been alive literally for centuries—we still know little of the relation of British settlement and Roman site—less indeed than of almost any other question in British archæology; and it is only now that investigations at St. Albans, Colchester, Llanmelin, and one or two other sites are gradually accumulating the needed evidence. In some phases of prehistoric archæology the available material along certain lines is plentiful; along others, certainly of no less importance, it may be scanty, or even entirely lacking.

It is not without significance that archæologists are now prone to speak of 'prehistory', perhaps even more than they use the term 'prehistoric archæology'. The change may be one of orientation only; but it is a change which carries with it many implications. The view has become broader. It is no longer adequate to study a site *per se*, to assign it to its period, or even to seek analogies of detail elsewhere. The prehistorian must look to its geographical and cultural relations, and his aim is rather to assign it to its proper place as an

index of cultural development and movement His method is synthetic rather than analytic

This change in point of view in the study of British archæology to day was foreshadowed before the War So long ago as the beginning of the present century, Lord (then the Hon John) Abercromby in his studies of bronze age pottery combined a detailed examination of form and ornament with a broad view of distribution and the inferences to be drawn therefrom as to cultural and racial movement, a piece of work which for many years had a marked effect on the work of British archæologists and of which the full force is not yet spent

At the same time, in the study of archæology, or rather prehistory, on the Continent, beginning with the Mediterranean area, much attention had been devoted to questions of distribution, interrelationship, and cultural and racial movement In these studies, British archæologists had no small share, but when they turned to their own country, in working out their problems, they found lamentable gaps in the evidence questions of distribution had scarcely been attacked, and there had been but few attempts to co ordinate information A recent writer has directed attention to how little, relatively, is really known of the Iron Age in Britain

Fundamentally the problem, to a great extent, is one of distribution A great advance was made immediately after the War by the appointment of an archæological officer to the staff of the Ordnance Survey Department This has assured greater attention and care in the recording of certain classes of antiquities, but the real need is for a whole series of maps recording the location of all classes of antiquities This covers only what is already known How much may yet remain to be dis covered is incalculable, but the aeroplane has revealed possibilities To it we owe Woodhenge Here the aeroplane brought to the knowledge of the archæological world a new and unsuspected type of prehistoric monument, and this is one only of the discoveries for which we are indebted to the Royal Air Force Within the last few days, aerial photographs taken in the course of military exercises have revealed four previously unknown temporary camps along the line of Hadrian's Wall between Wallsend and Gilsland, and indications at Housesteads and Chesters point to civilian settlement of a size and plan not previously suspected More important in the present connexion is it that these photographs suggest the lines of future re search Is it too much to suggest that training for the Royal Air Force in air photography, which can be carried out anywhere, might be combined with a systematic archæological survey of the country?

It requires no more than a superficial view of the present situation of archæological studies in Great Britain to see that the need of the moment is synthesis and organised research—investigation along lines on which information is least adequate This involves a mobilisation of information and co operation between the various archæological interests throughout the country In Northern Ireland, as noted elsewhere in this issue, a movement has been initiated to record all ancient monuments within a certain area, with all obtainable information concerning them Similar records for England, Scotland, and Wales are eminently desirable They would form an admirable basis for the fuller archæological survey which we feel a necessity for any real advance in archæological studies In the meantime, the Congress of Archæological Societies has published the first report of its Research Committee, which was appointed in 1929 We commend this most valuable document to all who are interested in archæological studies, for the Committee, in advocating a policy of cooperation and organised research, has enumerated for each period of prehistory the problems which it will be the task of research to solve

The New Survey of London

The New Survey of London Life and Labour Vol 1 *Forty Years of Change* Pp xv + 438 (London P S King and Son, Ltd, 1930) 17s 6d

THIS continuation of Charles Booth's Survey of London, of forty years ago, has everything to commend it The new editor-in-chief, Sir Hubert Llewellyn Smith, quotes very aptly from Charles Booth on his title page "Comparisons with the past are absolutely necessary to the comprehension of all that exists to day, without them we cannot penetrate to the heart of things" The original Survey, which began to appear in 1889, was the work of one rich, enlightened, and benevolent man It has now been taken up again by a combination of public bodies, centring in the London School of Economics, and under the direction of the sometime Permanent Secretary of the Board of Trade The change is significant of the vast advance in organisation and socialisation which has taken place in the interval This introductory volume testifies to many other changes in the life of the people of London, and the pleasantest thought, after reading it, is that, on the whole and in almost every

measurable aspect, the people of London are better off than when Charles Booth first surveyed them

The various signs of this improvement, and the fundamental causes for them, are, as we might expect, either directly scientific or akin to science We may distinguish three or four First, the increase in organisation and its better direction to social ends Allied with this must be mentioned the organisation of the workpeople, which has been the chief agent in securing their substantial rise in wages Next must be placed medical and sanitary science, which has in the period made London by far the healthiest of the great cities of the world Lastly—put first in importance by some of the contributors to the volume—comes the general elementary education of the people, which has been successfully enforced by an admirable civic organisation So successful has this been that for the most part compulsion is now unnecessary, both parents and children now accept the school law as part of the law of Nature, and the latter are enthusiastic about it

On each of these aspects a few words may give some idea of the contents of this most carefully executed and inspiring volume

Organisation, especially as applied to transport, is probably the factor which has made the most palpable change in London in the forty years Our whole present system of underground trains, with electric buses and trams, has been evolved in this time It is the best in the world, and has altered the conditions of life more than any other single factor Quicker transit, over longer distances, has taken the bulk of the population into fresher air and less crowded surroundings The change has also opened the eyes of the public to the intolerable legacy of the slums which remain

The rise in wages and the lowering of hours of work are treated in great detail and with strictly corrected statistics Broadly speaking, and allowing for the rise in the cost of living, the workmen of London are 30 per cent better off than when the first Survey was published, and they gain this 30 per cent for a working day of about an hour less in duration The so-called 'unskilled' have gained proportionately the larger part, but the advance is general

The use made of this increased leisure and means is treated rather summarily in this introduction, and we shall look for a more thorough account later on But on two other aspects the reporters are emphatic These are health and education The improvement in public health is so remarkable that we must give a few of the figures Since 1880 the death-rate per thousand has been nearly halved, having gone down from a little more than 20 per thousand to a little less than 12 In the case of infants, the decrease is far greater, for the death-rate per thousand for them was in 1880 about 150, and had been more, while in the latest returns included in this book it has fallen to 68 Dr Wheatley, who is quoted on this subject, attributes the improvement mainly to the growth of an educated public opinion "The saving of child-life came about as soon as a generation which had passed through the primary schools had become the parents of a new generation" No doubt the accompanying fall in the birth rate accounts for a good deal in this result Having fewer children, mothers are freer and more determined to take the utmost care of those they have But it is shown by the statistics that the improvement had begun before the fall in the rate, and many points in child welfare have been sedulously inculcated in recent years by all sorts of beneficent organisations outside the schools

If one is to criticise at all, it would be that the reporters are inclined to be somewhat too optimistic with regard to the level of education and the direct result of school-teaching Two of their conclusions suggest this remark One is the statement, sometimes explicit and oftener implied, that we have now achieved an 'educated' population in London, if not an educated democracy as a whole This surely puts the advance far too high A special inquiry, as careful and expert as this, into the education of the people of London would be a valuable and enlightening thing It would, one fears, lead to a rather less roseate picture than is given of the definite and measurable improvements in health, wages, and transport Connected with this point, one is inclined to surmise that the great improvement in the mortality statistics is more largely due to better sanitation and health administration, as well as the rise in the standard of living, than to the education provided by the schools But the subject obviously is a very complicated one, and no one would wish to lessen the credit due to the teachers and to the education service generally, which, as organisation, is perhaps the most admirable thing which Great Britain has carried through in the time of this review

Three blots disfigure the otherwise bright tableau which is unfolded One, the most conspicuous, is what is commonly known as 'Poplarism' Entirely within this period, the habit has grown up in certain large areas, both in London and elsewhere, of treating poor law relief as an habitual resource, in place of, or in supplement to, wages The

growth of this evil and the recent efforts to stem it are faithfully described The second, less rampant, but significant and disturbing, is the increase of certain classes of sexual offences amid a general and very considerable fall in crime The third, directly connected with the growth of motoring and possibly with the employment of the police in controlling motor traffic, is an increase in burglary—not, as is sometimes supposed, in the London area itself, but in the surrounding belt which may be reached, raided, and left by the motor bandit This is one of the incidentals of a scientific advance, and still leaves us well behind Chicago

F S MARVIN

The Life-Work of Francis Galton

The Life, Letters and Labours of Francis Galton By Prof Karl Pearson Vol 3*a* *Correlation, Personal Identification and Eugenics* Pp xiv + 440 + 44 plates Vol 3*b* *Characterisation, especially by Letters Index* Pp vi + 441 673 + 18 plates (Cambridge At the University Press, 1930) 69*s* net

THE completion of this great " Life " of a great man is an achievement, and we wish to express what all interested must feel, that the library of science has been enriched in a very noble way We venture to congratulate Prof Karl Pearson on the success of his undertaking , he has given us a painting by a master No doubt it has been a labour of love and not without the artist s joy , but it has meant many years of strenuous sifting and appreciating and arranging to elaborate this worthy record of the life and work of one of the most notable pioneers in the history of civilisation Therefore, if we may be a mouthpiece, we would simply thank Prof Pearson for this monumental work, surely never excelled in completeness, accuracy, insight, and keen judgment flashing like a two-edged sword We have to congratulate our science that such a biographer was available and willing, for no one else could have summed up Galton's labours with such competent authority or pictured the man with such sympathetic understanding

On the whole, we suppose, we should be glad that it has been possible to complete the work on the same grand scale throughout , and it is something to be proud of that wise generosity has helped to make it possible In these two concluding parts (vols 3*a* and 3*b*) there are 673 pages and 59 plates, besides beautiful frontispieces—the whole a great credit to the Cambridge University Press The volume is expensive , but good value for the money What the biographer says in this connexion is of refreshing interest He points out that he has devoted to his task much of his time for twenty years, and that he made up his mind from the outset that the biography should be done to satisfy himself and without regard to traditional standards, to the needs of publishers, or to the tastes of the reading public " I will paint my portrait of a size and colouring to please myself, and disregard at each stage circulation, sale or profit " There is a delightful breeze about this—a suggestion of one of the great masters , and the publication has been accomplished Our only regret is that the price of volumes so monumental and magnificent is prohibitive for most of us—especially perhaps for those with youth on their side, who are naturally attracted to new movements, such as the one to which Galton gave so much of his pioneering energy

The biographer's second reason for being anything but apologetic for the size and splendour of his volumes is that it seemed to him well worth while to gather together, once for all, everything that contributed towards a complete appreciation of Galton's labour and thought In a short time, verification becomes difficult and documents disappear , so Prof Pearson resolved to preserve in permanent form all that is essential ' In the centuries to come, when the principles of eugenics shall be commonplaces of social conduct and of politics, men, whatever their race, will desire to know all that is knowable about one of the greatest, perhaps the greatest scientist of the nineteenth century " So be it, and their gratitude will be added to ours What is needed, however, since these dignified volumes are frankly too expensive for first class minds with third-class purses, is the preparation of a relatively small volume, like the recently published admirable appreciation of Erasmus Darwin, available to all who wish to learn what this great life has to teach , and if the veteran biographer cannot do it himself, he has not to look far for one who can

In vol 3*a* we find (1) an account of Galton's work on correlation and the application of statistics to the problems of heredity , (2) a discussion of what Galton did with reference to finger prints , and (3) the story of the last decade of his life and the concentration of his many endeavours to make eugenics an ideal for educated men and women Vol 3*b* is devoted to characterisation, especially by means of letters Both volumes are generously and beautifully illustrated

We wish to refer briefly to a question of terms used in reference to eugenics If eugenics be " the study of those agencies which under social control

may improve or impair the racial qualities of future generations either physically or mentally it does not seem to us that anything is gained by calling it a creed still less a religious faith But Galton was very strongly of the opposite opinion He considered various definitions and affirmed that the direction of the emotions and desires towards a furtherance of human evolution recognised as rightly paramount over all objects of selfish desire justly merits the name of a religion His biographer corroborates this usage for he writes

Man has learnt how to breed plants and most inferior forms of life that are of service to him He has yet to learn how to breed himself When he has studied heredity and environment in their influence on man the application of the laws thus found to the progressive evolution of the race will become the religion of each nation Such is the goal of Galtonian teaching the conversion of the Darwinian doctrine of evolution into a religious precept a practical philosophy of life Is this more than saying that it must be the goal of every true patriot ? This last question hits the nail on the head The eugenic ideal of improving the human breed is a goal an aim an ambition but it is scientific not religious There is nothing mystical about it as there is in all religious activity according to the great majority of its competent students We should not have lingered over this point did not the usage sanctioned by Galton and Pearson both so nearly perfect in precision seem to us to be somewhat of a hindrance to the diffusion of the eugenic ideal or aim That the eugenic endeavour should come to have an intensity comparable to that of a high religious aspiration is indeed our hope and prayer but that is not the question before us

As we read the story of Galton s life and labours and recall what we read in the previous two volumes a good many years ago we cannot repress a feeling of almost embarrassing admiration For Galton was a genius in the sense that he had abilities of unique pattern and at a high power of intensity yet all regulated by indefinable wisdom by magnanimity and by a great kindliness Having had unforgettable experience of this characteristic kindliness we can understand in some measure the feelings of those who stood around Galton s grave in Claverdon churchyard in January 1911 What we felt deeply was the personal loss of that gentle affectionate and modest nature generous in thought and in practice here bestowing an idea and there a helpful hand rarely saying a harsh word and often moderating the acerbity of others taking life earnestly, but with a saving sense of humour he would have been of earth s elect even if he had never achieved high rank in science It was the loss of that ever flowing spring of understanding human sympathy that we felt most bitterly What an outstanding argument for eugenics the man was !

On those qualified to judge Galton s work has left the impression of a mind of the first rank and there was a characteristic freshness retained throughout life which enabled him to illumine whatever he touched We must think of his contributions to medicine evolution anthropology geography psychology heredity and statistics—showing a marvellous many sidedness To this quality so convincingly documented in these volumes the biographer playfully referred when he took the chair at Galton s famous address to the Sociological Society in 1904 on Eugenics its Definition Scope and Aims If I wanted to know how to put a saddle on a camel s back without chafing him I should go to Francis Galton if I wanted to know how to manage the women of a treacherous African tribe I should go to Francis Galton if I wanted an instrument to measure a snail—or an arc of latitude—I should appeal to Francis Galton If I wanted advice on any mechanical or any geographical or any sociological problem I should consult Francis Galton And it was not in the least that he was an incarnated encyclopædia it was rather that he had unusual fertility lucidity and elasticity of mind—an ever youthful mind save that it grew wise

It is not for us to pay compliments to the distinguished continuator of the work of a great initiator but in our position for the moment as reviewer we must be allowed to express our admiration at the perspective and proportion that mark these volumes Amid the manifoldness of recorded achievement there is no crowding or jumble and this is the reward granted to an artist who mixes his paints with brains There was a unity underlying all Galton s varied work which only reveals itself when after much inquiry and retrospection we view it as a whole and with a spirit trained to its modes of thought Twenty years of almost continuous reflection on Galton s labours have enabled me to see using his own words the whole as a permanent panorama painted throughout with equal colours and to grasp better how great diversity of production may nevertheless be consistent with a marvellous unity in the main aim of a life For the dominant and unifying idea of Galton s life s work was to measure the influence of heredity on the mental and physical attributes of mankind in order that a true knowledge of natural

inheritance might enable man to lift himself to a loftier level"

In our judgment, Francis Galton should be for ever memorable (1) as a vindicator of the rôle of statistics (in the broad sense) as an organon of research, and (2) as one of the three founders of the science of heredity Darwin had indeed shown that the facts of heredity are amenable to scientific treatment, but the three men who laid the foundation-stones of genetics—the science behind eugenics—were Galton, Mendel, and Weismann, each with his characteristic contribution—biometric, experimental, and cytological respectively It is, of course, of great interest that while Weismann's work was quite independent, it was anticipated by Galton in its idea of the continuity of the germ-plasm (which the biologist of Freiburg *demonstrated*), and in its scepticism as to the transmissibility of acquired characters Galton and Mendel were both born in 1822, Weismann's year was 1834 We believe we had the honour of directing Weismann's attention to Galton's earliest papers, of which he was unaware, and at that date neither of them knew anything about the lamentably well hidden treasure of Mendelism It meant a retardation of progress that the three foundation layers were independent contributors rather than co-operators, but this has happened repeatedly in the history of science

But what was Galton's chief service to mankind? It was not exactly the new method of biometry nor the scientific foundation he gave to the study of heredity It was not even his vision of eugenic possibilities, for though this was fuller and clearer to Galton than to any previous investigator, the eugenic ideal of having a fine family is one of the oldest ambitions in the world Galton's greatest service was in being a pioneer in thinking of man biologically Just as Darwin, his great cousin, discovered man as an evolved species, solidary with the rest of creation, so Galton saw man as a species evolving, and if evolving, then with a progress and retrogress that can be more or less understood, and thereby more or less controlled By application of biological laws, man may learn to breed himself as he breeds his crops and stock, though to even finer issues That was the new idea, the new hope, the *novum organon*—to use science for life, man must learn, in Pearson's fine phrase, "to tame by science the nescient waywardness which lays waste his stock" He has learnt not a little in the moment of time since Galton died, thanks to the eugenics laboratory on one hand and eugenics societies on the other, which ought to work in the heartiest co-operation, and he will learn more rapidly whenever he cares more about it Heaven forfend that he should learn too late, for that would be the grimmest of all ironies

If man is to control his own evolution in the light of science, he will need all the science he can get—not of heredity alone, but also of functioning and environment as well, eutechnics and eutopias as supplements to eugenics Since the organism is a unity, the aid of eupsychics must be also invoked, and of moral education too, even more than Galton would admit As sociologist, Galton was more or less free from the biologisms which take the pith out of many eugenic endeavours for it is a terrible fallacy to ignore the differentiating 'social heritage', which is as supreme as Galton's 'natural inheritance' is fundamental Moreover, we often wonder whether the outlook of initiator and continuator alike might not have gained by recognising that we need in our eugenics more than *human* biology For in the animal world there have been eugenic achievements strongly suggestive of heights to which man, usually so badly shackled and enmeshed, has not as yet approached But that is another story!

Galton has been well called "a *religious* agnostic", and here the word religious is used in its proper sense, to indicate the sending forth of tendrils towards the Supreme Reality "Galton believed in a recondite purpose in the Universe, which we men cannot unriddle, and he urged his fellows with religious earnestness to take up the burden of their task and further develop their species in fitness to its environment Increased vigour of mind and body appeared to him the aim of the power which we seem to discern working obscurely, and as if with difficulty, behind the apparently blind Forces of Nature" *In hoc signo laboremus*

Liberia and the Belgian Congo

The African Republic of Liberia and the Belgian Congo based on the Observations made and Material collected during the Harvard African Expedition, 1926–1927 (Contributions from the Department of Tropical Medicine and the Institute for Tropical Biology and Medicine, No 5) Edited by Richard P Strong In 2 volumes Vol 1 Pp xxvi+568 Vol 2 Pp ix+569-1064 (Cambridge, Mass Harvard University Press, London Oxford University Press, 1930) 67*s* 6*d* net

DR R P. STRONG states in his introduction that the Harvard African Expedition of 1926–27 was planned, first, for the purpose of

making a biological and medical survey of Liberia, the interior of which even now, although within twelve days of Great Britain, is, as Sir Harry Johnson stated in 1906 in his book "Liberia", still the least-known part of Africa, and secondly, to cross the continent from west to east, travelling particularly through the Belgian Congo After the survey of Liberia was completed, the expedition proceeded by sea to the Congo and up that river to Stanleyville, continuing up the Lualaba to Kabalo, then eastward to Albertville on Lake Tanganyika, afterwards travelling northward via the Lakes Rift, and eventually reaching Mombasa by way of Lake Victoria and Nairobi

The first 200 pages of vol 1 of this wonderfully well got up and beautifully illustrated book, dedicated to Mr Harvey S Firestone, are of special interest, being devoted exclusively to the Black Republic, its climate, inhabitants, agriculture, medical and social conditions, and its natural history There are also chapters dealing with slavery and maladministration in the hinterland of Liberia which afford ample confirmation of the findings of the recent International Commission of Inquiry Dr Strong writes in relation to the periodic tours in the interior, of the Commissioner-General and the major commanding the frontier force, who are usually accompanied by a large number of soldiers, messengers, and others

"Official regulations require the natives of the hinterland to furnish porters for the government The porters receive no pay After these visits the towns or villages are frequently left in at least temporary destitution, for apparently almost everything of value is taken away Goats, poultry, and other food supplies, the few animal skins or articles of native manufacture in the town, and sometimes even the young or more attractive girls, disappear There is no redress for this extortion To avoid it, villages are sometimes abandoned and groups of natives abscond across the border, not always to return This practice of raiding by the District Commissioners, however, has become more or less known In 1926 the Liberian legislature made an investigation, in which two aboriginal native Commissioners (not Americo-Liberian) were concerned It disclosed the fact that in the name of providing entertainment for the President, who was making a tour of the hinterland, several native Commissioners had collected from the natives, without payment, about 200 goats, 585 hampers of rice, 40 tins of palm oil, 400 chickens, and other articles of food, to the total value of $1600 Although the President found it impossible to visit the area, the Commissioners kept the food After the investigation, the House of Representatives passed a resolution asking that the salary of one of the Commissioners he withheld until he returned the articles *to the government*, and that the other Commissioner be dismissed Obviously, however, it is exceptional to make any excuse, such as a possible visit of the President, for such raids upon the villages"

The book is first and foremost a valuable addition to our general and detailed knowledge of the diseases of tropical Africa, west coast and central Africa in particular, their causation and transmission, as well as their histological pathology—for since the expedition returned to America a vast amount of work has been done on the material that was collected Malaria, the most prevalent of all diseases in the tropics, and of the first economic importance, is dealt with mainly in relation to the incidence of infection in various localities The routine malaria work carried out during the progress of the expedition affords some interesting results "Almost no one", state Drs Strong and Shattuck on p 212, vol 1, "doubts the value of the splenic index as affording a simple and rapid method of estimating the degree of malaria in some infected areas, but on the other hand it certainly does not furnish means of discovery of all malarial infections, and it would be exceedingly unwise in certain tropical districts to assume that all cases of splenomegaly are necessarily malarial in origin"

Much of the recent work on splenomegaly is summarised, yellow fever, filariasis, and other mosquito-borne diseases are usefully discussed, and again much of the recent work on these diseases is summarised for the student During the course of the investigations in Liberia, some discoveries were made in connexion with *Onchocerca volvulus* and *Simulium damnosum*, the large black, white-footed simulium known as the 'Jinja fly', first named by Theobald from specimens collected at Jinja, near the Ripon Falls, by the reviewer, whose description of the sanguinary appearance of the bare legs of his tormented porters on the Jinja-Kampala road inspired the name *damnosum* The Harvard Expedition's observations with reference to *Simulium damnosum* as the transmitter of *Onchocerca volvulus* are apparently the first to confirm the very important ones of Blacklock published a few months previously The discovery of the relation of onchocerciasis to keloid formations and juxta-articular nodules is also of importance Much space is given to yaws and syphilis, and many interesting photographs of cases met with are shown

Though well known to the natives of the interior, human trypanosomiasis—sleeping sickness—was found to be rare in Liberia, only five cases of

trypanosomiasis being discovered, all from one district, although *Glossina palpalis* was common, and in only one tsetse fly were trypanosomes detected Animal trypanosomiasis was also found to be rare in Liberia In the Congo, of course, conditions were very different, and more space is devoted to the subject in dealing with that region

In Chap xxvi we find useful information on economic plant diseases No infectious disease, however, was found to affect the oil palm which is extremely common in Liberia, much more so than in the neighbouring protectorate of Sierra Leone, and should be of great commercial importance The question of whether monkeys may act as hosts for the malaria parasites of man is considered in Chap xxvii, and the reader will experience a sense of relief at the realisation that there is still no evidence that malaria can be transmitted from the apes to man, although plasmodia, in some cases indistinguishable under the microscope from malaria parasites in the blood of man, are not uncommon in both monkeys and the apes Beautiful coloured illustrations of these latter protozoa are given in Chap xxx

An interesting botanical report of Liberia, with some very good reproductions, concludes vol 1

Vol 2 deals with the mammals and birds of Liberia, birds collected in the Belgian Congo, and medical and economic entomology It does not contain merely lists of specimens obtained on the expedition and descriptions of new species, but also aims at mentioning all the species hitherto collected from this region, thus enhancing the value of the work from the systematic point of view

C Christy

Our Bookshelf.

Die Rohstoffe des Tierreichs Herausgegeben von Ferdinand Pax und Walther Arndt Bd I, Lief 4 Pp 161-320 12 75 gold marks Lief 5 Pp 321-448 12 gold marks (Berlin Gebruder Borntraeger, 1930)

The first 48 pages of the fourth part of this work contain the concluding portion of the chapter on fats, and deal with (1) the occurrence, extraction, characters, and use (largely as the basis of cosmetics) of spermaceti, (2) the animal fats employed with vegetable fats in the manufacture of soap, (3) ox-gall and its uses in industry, chiefly in colour work, and (4) fossil bitumina, including asphalt and petroleum

The remainder of the fourth part and the whole of the fifth are devoted to a consideration of the skins and membranes of animals used in commerce Accounts are given of hides and the modes of drying them, and of the chief methods of preparing leather The nature and varied uses of the skins of elasmobranch and other fishes and of reptiles and birds are described Reference is made to the damage caused by 'warbles'—the larvæ of *Hypoderma*, which in Germany in 1929 was estimated to amount to nine million marks Short accounts are given of the uses of leather in ancient and in medieval times, and of the present usage of leather by natives in different parts of the world, and a note is added on leather money,

The section on the preparation and usage of membranes derived from internal organs shows what each part of the alimentary tract—œsophagus, stomach, small and large intestine—yields in commercial products Here is found information on the preparation of goldbeater's skin, usually made from the outer layer of the cow's cæcum, of catgut, now made from the small intestine of the sheep, and of the coverings for the vast quantity of sausages consumed, especially in Germany and Austria

The final chapter, on furs, opens with a description of the different types and arrangement of hair, and the successive changes in the hair and its colour during the growth of the animal This is followed by an account of the North American and Russian fur trades A survey (unfinished) of the principal furs of commerce is arranged in systematic zoological sequence, beginning with the Monotremes

These parts present a compact source of information which is rendered readily accessible by the use of subheadings in heavy type In each section, historical data are given, and a bibliography is appended

Determination of Orbits of Comets and Asteroids By Prof Russell Tracy Crawford Pp xi + 233 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1930) 20*s* net

In Nature, July 14, 1928, a note appeared on the second (reset) edition of Bauschinger's "Bahnbestimmung der Himmelskörper", with an appeal for an English translation Bauschinger's treatise, however, had not been brought up to-date since its first appearance in 1906, and was expensive (£3) These defects were remedied a year later in a volume by Stracke, of the Rechen Institut in Berlin, which dealt with modern methods (except Leuschner's) including their adaptation to calculating machines But there has been no text-book in English since Watson's "Theoretical Astronomy" in 1867 Prof Crawford has now filled this gap in our literature In order to keep his book within the bounds of a university text book that can be mastered in a one year's course, Prof Crawford has assumed a working knowledge of spherical astronomy He develops his subject concisely, and leaves the more difficult subjects of perturbations and definitive orbits for later and more specialised study The two methods described are a modern adaptation of Laplace's by Leuschner, and a recent modification of Gauss's by Merton The former is the favourite method in America, but it has never been taken

up by anyone who has not been to Berkeley and studied under Leuschner himself The latter is a modernised version of the methods in vogue on the Continent and it is unlikely that it will yield on this side of the Atlantic, to Leuschner s method It offers more straightforward processes and greater facilities for checking at each stage

The first three chapters by themselves enable a computer to prepare an ephemeris of a body from its known elements and also to comprehend fully the motion of a body moving under a central attraction The tables that accompany the work are printed with flat figures American printers have not yet realised that head and tail figures only are used in the best tabular productions Otherwise the book is well printed and it will certainly be welcome wherever English is spoken L J C

Religion and the Reign of Science By F Leslie Cross (Anglican Library of Faith and Thought) Pp x + 111 (London New York and Toronto Longmans Green and Co Ltd 1930) Paper 2*s* 6*d* net cloth 4*s* net

MR CROSS is inclined to think that the religion and science controversy has lost interest and that this is due to a prevailing scepticism which is having a disintegrating effect upon culture in general People have certainly turned away from the older type of apologetic but they are still interested in trying to see how scientific theories affect their philosophy of life and Mr Cross s book should help them to form intelligent opinions here He points out that the development of science has led to an increase in the range of casual determination but a decrease in that of final determination Everything had its cause but nothing its reason Not only miracles and prayer but even human freedom seemed altogether ruled out

Mr Cross holds that the question of freedom is more important for religion to day than the question of miracle The unbelieving multitudes to day are little helped by miracles and he gives a very able summary (pp 30 and 31) of the bearing of recent physical theories upon the problem of freedom He is not guilty however of trying to exploit the new physics in the interests of theological theory and warns us that the views of such thinkers as Whitehead Eddington and Jeans are highly individual and have received little assent from the learned world This is a very competent and useful book

The Archæology of Kent By R F Jessup (The County Archæologies) Pp xiv + 272 + 13 plates (London Methuen and Co Ltd 1930) 10*s* 6*d* net

IF London justly holds first place in the County Archæologies on the ground of its historic importance Kent is no less entitled to the second place for its archæological interest It is a county peculiarly rich in relics of the prehistoric and early historic periods It was in its plateau gravels that Benjamin Harrison found the famous eoliths over which controversy is not yet stilled Kit s Coty House and Coldrum are amongst the most interesting of our megalithic monuments and in Richborough which for some years has been under excavation by the Office of Works and the Society of Antiquaries it possesses a site which was in occupation by the Romans for practically the whole of the period of their stay in Britain Its Saxon relics are no less interesting for the light they throw on the relations of Kent both with the Continent and the rest of England The evidence for the various periods is passed in review by Mr Jessup but his account of Kent in the neolithic bronze and early iron ages will be particularly appreciated as this is the first time that the detailed evidence has been brought together His treatment of eoliths may appear a trifle over cautious and it would have been an advantage had he dealt more fully with the physical characters of the various races who settled in the county

Insomnia an Outline for the Practitioner By Dr H Crichton Miller Pp xi + 172 (London Edward Arnold and Co 1930) 10*s* 6*d* net

DR CRICHTON MILLER who is the director of the Tavistock Square Clinic is to be congratulated on his book on insomnia It is probably the best book on the subject It is not too long and is extremely well set out The author has not shown any hide bound prejudices and treats each case strictly on its merits In so many cases there is an emotional factor at work and until this is satisfactorily dealt with it is quite useless giving drugs and trying to cure the insomnia In the chapter on the psychological aspect of insomnia the various views on the conflict of life are placed before us In this chapter Dr Crichton Miller is careful to point out that Jung s views are more philosophical than scientific he is at heart a mystic The chapters on general treatment and medicinal treatment are good although we would like to see psychotherapeutic nurses have a training of twelve months in a mental hospital not three to six months !

Vorlesungen über Wellenmechanik gehalten an der Staats Universitat zu Columbus U S A Von Prof A Lande Pp iv + 132 (Leipzig Akademische Verlagsgesellschaft m b H 1930) 9 50 gold marks

THESE lectures are more in the nature of comments on wave mechanics than a formal treatment This is especially true of the first three sections on waves and corpuscles the uncertainty principle and quantum statistics in which the points of similarity and dissimilarity between the old and new ideas are brought out with great clarity Under the second head Prof Lande gives a neat derivation of the number of degrees of freedom in a system of stationary waves taking as fundamental the conception of cones of radiation a method usually explicitly avoided in this connexion The remainder of the book contains an outline of the applications of wave mechanics on more stereotyped lines and includes accounts of the derivation and applications of the simple wave equation the wave mechanics of systems undergoing temporal change and relativistic wave mechanics

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Phenomena in a Sounding Tube

FROM the recent papers by Mr P S H Henry [1] and others, it appears that interest is being taken in the phenomena which occur in a sounding tube It may be well to direct attention to some results I have obtained, publication of which will shortly take place, having been delayed by illness

Direction of circulation at the centre→

Node Direction of circulation at the wall← Antinode

FIG 1 -Node to antinode circulation in dust free air

There are two main phenomena which have been hitherto undetected in experimental work on Kundt's tube, one of which takes place in the absence of all dust and is a free circulation of the air, while the other is caused by the presence of dust particles In general particles of dust of the size and mass used are much too massive to act as tracing points for the air motion, but behave rather as obstacles over which the vibrating air washes, although they may partake to some extent of the motion Particles of smoke, however, can be shown to take up the full motion of the vibrating air for ordinary acoustic frequencies, although with supersonic frequencies they do not, a point on which investigations are being carried out here At a frequency of 1200 per second, for example, the ratio of the amplitude (or velocity) of the smoke particle to that of the air is 0 9996

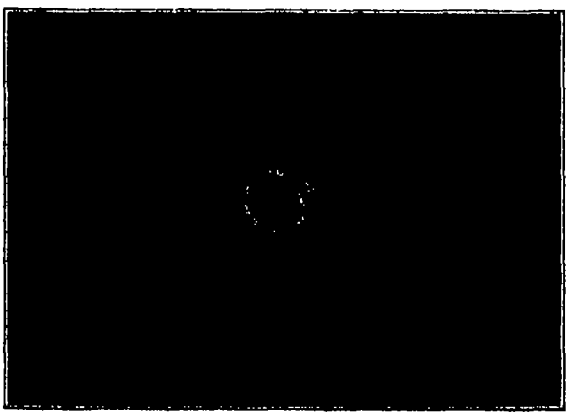

FIG 2 —Vortex system formed round a sphere by vibrating air The obstacle has been emphasised otherwise the picture is an untouched print The vertical band extending above the obstacle is a shadow, not a material bar

Using smoke in a tube containing air set in vibration by a valve maintained diaphragm[2] a perfectly regular circulation of air, from antinode to node along the walls and returning down the centre of the tube, has been detected The nature of the circulation can be clearly seen from the photograph reproduced in Fig 1, which represents part of a long tube of 3 5 cm diameter, the wave length being 56 6 cm A circulation of this kind was predicted by Lord Rayleigh,[3] who believed that something of the kind had been seen by Dvorak What Dvorak saw, however, was a motion of large particles of quite a different nature, as will be made clear in the forthcoming publication The lines of flow of the motion shown in Fig 1 agree pretty closely with those that can be computed from Rayleigh's formula, the main difference being that the distance from the wall to the surface at which the direction of flow reverses is found experimentally to be 0 33 times the radius, while according to Rayleigh's calculation the figure comes out to be 0 293

The other new phenomenon is the motion of the air caused by the presence of an obstacle, and hence by a particle of dust, the inertia of which is sufficient for there to be a large motion of the surrounding air relative to it When certain critical conditions, suggested by application of the principle of dynamical similarity, are satisfied, a vortex system of the type represented in Fig 2 is formed round a spherical obstacle, a similar system, modified in the general way to be expected, has been detected round a cylindrical obstacle This is believed to be the first example of a vortex system generated by a vibrating fluid

FIG 3 —Method of formation of dust ridges by means of vortices

Such vortices are the cause of the ridge systems which form in an excited Kundt's tube, the general method of formation of the ridges being illustrated in Fig 3, where two cylindrical obstacles, lying on the floor of a flat tube, are shown in equilibrium It has been found that a combination of the general circulation and of the vortex motion caused by particles can account for practically all the phenomena which take place in a dust tube

E N DA C ANDRADE

Carey Foster Laboratory,
University College, London,
Feb 27

[1] *Proceedings Physical Society*, vol 43, part 3, No 238
[2] NATURE, Nov 9, 1929
[3] Collected Papers , vol 2, p 230

Determination of the Molecular Weight of Insulin

AT the suggestion of Dr H Jensen, of the Johns Hopkins University, Baltimore, an ultracentrifugal investigation of insulin has been carried out in my laboratory by Mr B Sjögren A quantity of 0·25 gm crystalline insulin was kindly put at my disposal by Dr Jensen, and this small sample proved sufficient

for a fairly complete study of the molecular weight and pH stability region of insulin

Twelve determinations of the sedimentation of insulin in centrifugal fields 100,000 times the force of gravity at 20° C over a pH-range of 3 5 12 3 showed that insulin is stable from about pH 4 5 to about 7 0 The sedimentation constant has a value of $3\ 47 \times 10^{-13}$, which is very close to the value $3\ 54 \times 10^{-13}$ previously obtained for egg albumin, and that for Bence Jones protein, namely, $3\ 55 \times 10^{-13}$ When the stability range is exceeded, dissociation into low molecular products takes place This dissociation is reversible if the substance has not been brought too far into the acid or alkaline region and has not been kept there too long

Three determinations of the sedimentation equilibrium of insulin at a pH of 6 7-6 8 gave as a mean value for the molecular weight 35,100, which within the limits of experimental error is the same as that for egg albumin, 34,500, and for Bence Jones protein, 35,000 For the partial specific volume the value 0 749 was obtained This constant also is identical with that of egg albumin and Bence Jones protein A calculation of the molar frictional constant from the above data gives the result that the insulin molecule is spherical, which is also the case with the molecule of egg albumin and Bence Jones protein

The sedimentation equilibrium determinations show that crystalline insulin is homogeneous with regard to molecular weight, that is, the molecules in the sample studied were all of the same weight

The above results seem to demonstrate that insulin is a well defined protein belonging to the same class as egg albumin and Bence Jones protein (compare NATURE, June 8, 1929, p 871) As pointed out by Dr Jensen in a letter to me, this fact makes it very improbable that the sythesis of insulin will ever become possible

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Uppsala, Sweden, Feb 21

Viscosity of Electrolytes

THE investigations of Jones and Dole [1] suggested to me the problem of studying the viscosity of strong electrolytes from the viewpoint of the theory of Debye [2] It is well known that Debye's theory assumes that each ion is surrounded by an 'ionic atmosphere' the total charge of which is equal and opposite to the total charge of the central ion

The ionic atmosphere has a definite thickness and in addition requires a certain time for its formation, which is called the time of relaxation Both the thickness and the time of relaxation are dependent in a definite manner on the concentration, the valence of the ion, the temperature, and the dielectric constant of the solvent Furthermore, the time of relaxation is a function of the mobility of the ions

The properties of the ionic atmosphere are of great significance in a consideration of the reversible thermodynamic and irreversible conductivity processes of strong electrolytes [3] They also make it possible to construct a picture of the irreversible mechanism that is involved in the viscosity phenomena exhibited by strong electrolytes To illustrate this, we might consider the following case Imagine a plane perpendicular to the axis along which the velocity of the ions is changing If we take into consideration the successive layers above the plane, it can be shown that as a result of the electric lines of force coming from the added electric charge, a force is built up on the central ion parallel to the x axis (see Fig 1)

The total shearing force which is produced over an area of one square centimetre lying perpendicular to the velocity gradient can be readily calculated In making this calculation, the negative ions with their deformed ionic atmospheres must also be taken into consideration In this case the distribution of the electric charge is complementary to the corresponding distribution of the charges in Fig 1 This force is proportional to the velocity gradient The proportionality factor is obtained by adding to the viscosity of the original solvent the effect due to the Coulomb forces existing between the ions

If we call the viscosity of the electrolyte η_γ in normal concentration γ (in mols per litre), η_0 the viscosity of the pure solvent, then I can derive the

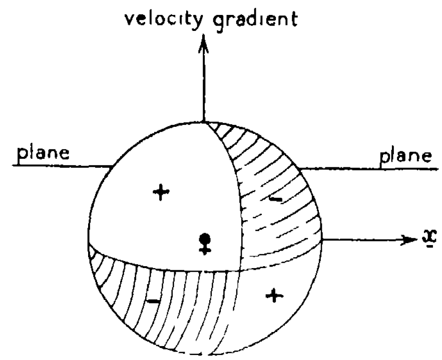


FIG 1

following relation theoretically which holds (or is applicable) in the case of dilute solutions

$$\eta_\gamma = \eta_0(1 + A\sqrt{\gamma})$$

In this expression A is dependent in a definite manner on the valence of the ion, its mobility, the absolute temperature, the dielectric constant, and the viscosity of the pure solvent η_0 For potassium chloride at 18° we obtain $A = 0\ 0046$ with water as solvent Recently Joy and Wolfenden [4] have verified this predicted value experimentally

In this connexion it may be interesting to note that I have recently calculated the general expression for the viscosity of any simple strong electrolyte and that I have also derived the general limiting law (*Grenzgesetz*) for viscosity phenomena The expression is the same as that indicated in the formula above, except that the coefficient A is in this case dependent in addition, in a much more complicated manner, on the mobilities and valences of both ions I do not propose to give the expression in detail here, for it is to be published shortly [5]

It would be very interesting to compare the theoretical results with systematic experimental studies, which will have to be carried out in the future A systematic investigation of the viscosity of weak electrolytes as a function of concentration, etc, would also be very interesting I believe that in this case the dependence of the viscosity on the concentration does not follow the square root law, but presumably is linear These linear terms are also important for the more concentrated solutions of strong electrolytes Perhaps it would be possible to develop further the exact differential equations pertaining to the problem so that this field may be explored In doing this, it will be necessary to take into consideration the relaxation effect of the dipole molecules of the solvent on the viscosity of the solution This has recently been calculated by Finkelstein, [6] according to whom this effect is proportional to the concentration

Although I am at present not fully convinced as to the validity of the quantitative values calculated by Finkelstein,[6] it nevertheless appears that some interesting explanations of the structure of electrolytic solutions are to be expected by comparison with experimental results

H FALKENHAGEN
(University of Cologne)

Chemistry Department,
University of Wisconsin,
Madison, Wisconsin, U S A

[1] Jones and Dole J Amer Chem Soc 51, 2950 1929
[2] Falkenhagen and Dole Zeit f physik Chem 6, 159 1929 also Phys Zeit 30 611 1929
[3] See the article by me entitled Modern Theories of Ionisation in the Chemiker Kalender, vol 3 pp 346 362 1931, or my forthcoming monograph on electrolytes
[4] Joy and Wolfenden NATURE Dec 27, 1930 p 994
[5] Phys Zeit In press
[6] B N Finkelstein Phys Zeit 31 130 165 1930

Electromotive Force of Dielectrics

I FOUND some time ago[1] that glasses in aqueous solutions show the electromotive force of a solid electrolyte the ion in the solid glass determines the potential difference against the solution Moreover, it could be shown that cations from the solution were exchanged against the cations in the glass the glass behaves then like a mixed electrode, but in a certain range of concentration practically like an electrode reversible to the ions taken up from the solution Glasses which show definitely the behaviour of a solid electrolyte (sodium electrode) also show always exchange electrodes particularly the silver and hydrogen electrode Certain soft glasses show only the hydrogen electrode except in alkaline solution

It was of interest to investigate whether other dielectrics would also show the same behaviour With J Hatner and lately with J E Ferguson, I investigated the electromotive behaviour of fused silica In this case also we found the existence of the sodium, silver, and hydrogen electrode

In the case of quartz, as in the case of glasses, the electromotive behaviour corresponds to the observations made when a current passes the solid

J E Ferguson and I[2] have investigated during the last year the electromotive behaviour of thin paraffin films We found also in this case the existence of sodium, potassium, hydrogen, and silver electrodes, and also (with some slight deviations, however) the existence of a calcium electrode, which we failed to find in any of the glasses investigated

These phenomena can be understood[3] if we make the following assumption The number of places available for cations in the dielectric is limited and constant $(=a)$ Only one kind of ion, cations, are taken up by the solid, and only these ions can migrate in the solid In the state of equilibrium the difference of potential, solid-solution, is the same for all kinds of ions present Neglecting the number of ions given off by the solid as compared with the concentration, c, in the solution, and treating the solid phase in first approximation like a dilute solution, the following formula is obtained for two kinds of ions present

$$E - \frac{RT}{F} ln \frac{\frac{K_1}{u_1} u_2 a}{c_1 + \frac{K_1 u_2}{K_2 u_1} c_2}$$

and ΔE the potential difference in the 'concentration cell' which alone is being measured

$$\Delta E = \frac{RT}{F} ln \frac{c_1' + Ac_2'}{c_1 + Ac_2} \left(A = \frac{K_1 u_2}{K_2 u_1} \right)$$

In this formula c_i are the concentrations in the solution, u_i are the mobilities in the solid phase, K_i are the integration constants in the expression for the thermodynamic potential of the ions present in the solid phase (solution tension)

In this formula all the terms can be measured directly, since also A is given by a single experiment For permutites and certain glasses, more complicated formulæ have to be used, since the ions in the solid phase cannot be treated as independent of one another, and since the amount of ions exchanged is comparable with the concentration of the ions in the solution

KARL LARK HOROVITZ

Physical Laboratory,
Purdue University,
Lafayette, Indiana,
Dec 26, 1930

[1] Zeit Physik 15, 1923
[2] Bull Am Phys Soc, Nov 1930
[3] This formula has been used by me since 1924 for the interpretation of different experimental results See, for example Bull Am Chem Soc April 1927, and J W V Osterhout, Bull Nat Res Council, 69, p 193, footnote 52 1929

Protein Structure and Denaturation

ASTBURY and Woods' fundamental work upon the micellar structure of the protein of wool fibres,[1] and the hypothesis they put forward as an explanation of the changes observed in the X ray pattern when such fibres are stretched, would seem to be full of significance for protein chemistry in general

Within the last ten years, different lines of evidence have been converging upon the view that some regularity, as regards pattern and molecular size, underlies the disordered confusion of data we possess relating to the proteins of the animal and vegetable kingdoms The two most striking demonstrations in recent years of such uniformity are afforded by Svedberg's brilliant application of the ultracentrifuge to determine the particle mass of soluble proteins,[2] classes of 'molecular weight' 1, 2, 3, and 6 times the common factor 34,500 being distinguished, and Gorter and Grendel's demonstration[3] that under appropriate conditions soluble proteins exhibit the phenomenon of surface spreading on liquids, and that all occupy the same surface area irrespective of particle mass (1, 2, 3, or 6 times 34,500) Using Svedberg's common factor 34,500 for the basis of their calculations, the Dutch workers obtain a value for the radius of the unit particle (22 5 A) identical with that determined by Svedberg experimentally

The most significant feature of Gorter and Grendel's work, however, is that their results imply a loosening, brought about by the surface forces, of the cohesive attraction holding the units of the aggregated proteins together Astbury and Woods' investigations reveal a somewhat similar, although internal, deformation of the keratin structure of the wool fibre, brought about by purely physical means Our conceptions of the chemical reactivity of protein structures clearly need revision in an attitude of greater attention to modern valence conceptions

One more point cannot be too clearly emphasised which is common to the essential findings of Svedberg, Astbury and Woods, and Gorter and Grendel the changes observed by these workers are strictly *reversible*

In conclusion, I should like to touch upon the problem of protein denaturation, and to inquire whether it is not in the direction of such work as that of Astbury and Woods that we have to look for a solution of this problem? Denaturation of proteins, which can be brought about by mechanical as well as by chemical forces, is characterised by a loss of solubility at the isoelectric point It was always thought to be an irreversible change, but Anson and Mirsky[4] have recently demonstrated its reversible nature in

the case of globin Some internal alteration takes place during denaturation, as evidenced by the change in reactivity of the sulphur groups,[5] but neither acid or base binding capacity [6] nor osmotic pressure [7] are affected—that is to say, there is no scission Clearly, loss of isoelectric solubility must be due to change in some internal tautomeric configuration

It is difficult to avoid the suggestion that a change, similar to that postulated by Astbury and Woods in explanation of the behaviour of the stretched and unstretched wool fibre, may in reality be the essential happening attending denaturation The -CO-NH- group possesses strong polarity, but, by the rearrangement of peptide linkages into what are virtually closed ring systems, affinity for water would be enormously diminished At present there exists no satisfactory hypothesis offering an explanation of denaturation Such a scheme as the above may reasonably be entertained until further evidence can be brought forward of a chemical or physico chemical nature which will throw more light upon the problem Considering the remarkable and wholly unexpected results, mentioned above, of Gorter and Grendel, working upon protein surface films, it would seem that quantitative data bearing upon denaturation is likely to be obtained most readily by studies having a similar approach The forces at play within the liquid and at the interface possess no mean magnitude They are, however, susceptible of more precise control and exact manipulation than those involved in, let us say, heat coagulation or the application of vigorous chemical reagents From a study of the surface phenomena exhibited by proteins under varying conditions, coupled possibly with an application of the X ray method to films of such proteins as can be made to give readily detectable diffraction photographs,[8] a solution not only of the denaturation process but also of the structure of native proteins may, in the future, be obtained

CLAUDE RIMINGTON

Biochemical Department,
Wool Industries Research Association,
Leeds, Feb 13

[1] Astbury and Woods NATURE, 126 913, 1930
[2] Svedberg, *Koll Zeit*, 51, 10 1930
[3] Gorter and Grendel *Proc Acad Sci Amsterdam*, 32, 770, 1929
[4] Anson and Mirsky *J Gen Physiol* 13 469, 1930
[5] Harris *Proc Roy Soc*, B 94, 426, 1923
[6] Booth *Biochem J*, 24, 158, 1930
[7] Huang and Wu *Chinese J Physiol*, 4 221, 1930
[8] Ott, *Kolloidchem Beih*, 23, 108, 1926

Stellar Structure

THE current argument against Helmholtz's contraction hypothesis concerning the origin of the sun's heat may be summarised as follows The gravitational potential at a point within the sun is of the order of magnitude of its value at the surface, 2×10^{15} c g s units Thus contraction may have supplied energy 2×10^{15} ergs per gram of the sun's mass The sun now radiates 1 9 ergs per second for each gram of its mass Further, the earth's crust has been solid for at least $1\ 6 \times 10^{9}$ years, during which time the sun may have radiated 9×10^{16} ergs for each gram of its mass Hence "it appears that the Helmholtz contraction-hypothesis cannot account for more than about two per cent of the energy which has been radiated by the sun during the earth's life" (Jeans, "Astronomy and Cosmogony", p 106) Further, there is astronomical evidence that the whole life of the sun has been at least of the order of 10^{13} years

It seems to have been overlooked that modern theories concerning the internal temperature and density distribution in the stars very much weaken, if they do not quite destroy the above argument If, following Milne,[1] we suppose that the mass of the star is much concentrated towards the centre, the first part of the above argument loses its force Fifty times as much energy can be accounted for The longer time period of 10^{13} years may be due in part to the sun's not having in the past radiated so much as it does at present

If the opacity of the stellar material varies as $T^{\frac{1}{2}}f(\rho/T^{3})$, where ρ is the density and T the temperature (the only theoretical formula in the field is of this form), it is possible that gaseous spheres of such material should contract to homologous density distributions and obey Lane's law Such spheres can exist possessing any mass, radius, and luminosity within certain limits, though, as I have shown,[2] this homologous contraction is a very special case The mass, radius, and luminosity, however, determine the rate of contraction The whole time required for the star to contract to its present size is $2(3R - C_v)MT/L$, where L and M are its present luminosity and mass, R and C_v the gas constant and specific heat of the material, and T the mean internal temperature

For the sun, taking mean temperature 10^{9} degrees, and $(3R - C_v)$ to be $2\ 5 \times 10^{8}$ ergs per gram per degree, this gives a past life of 8×10^{9} years This would be increased proportionately if, following Milne, we estimated the mean temperature of the sun higher The total energy radiated in the above life works out at $2\ 4 \times 10^{17}$ ergs per gram and the corresponding mean gravitational potential is $4\ 8 \times 10^{17}$ c g s units, not at all impossible if there is much concentration of mass towards the centre In its early stages, however, the contraction would have been much slower, since, for smaller T, R would have been larger, and the opacity also would have been larger than that given by the above formula Indeed, opacity varying as $T^{-1}f(\rho/T^{3})$ gives an infinite time scale

Helmholtz's hypothesis appears, therefore, by no means to be untenable

L H THOMAS

Department of Physics,
Ohio State University,
Feb 6

[1] NATURE Aug 16 1930 p 238
[2] *Monthly Notices of the Royal Astronomical Society*, November 1930, p 122

Replacing the Telephone by a Loud Speaker in Conductivity Measurements

IT seems improbable that nobody should have ever tried replacing the telephone by a loud speaker in conductivity measurements, but I have never heard of it, nor read anything about its possibility and advantages, I will, therefore, describe it very briefly, as I feel convinced that it represents a real improvement over the customary procedure

It consists simply in a two stage amplifier, with a factor of amplification of about 500, connected to a Kohlrausch bridge for measuring electrolytic conductivity, instead of the usual telephone, which is replaced by loud speaker If, instead of a buzzer, a shielded oscillator is used, and if all the leads are lead covered and properly earthed, the apparatus can be adjusted to give a musical note of variable intensity which permits the determination of the minimum sound much more easily, agreeably, and even a little more accurately than with the telephone I have found it a great improvement, and I hope this letter will encourage those interested in resistance measurements to try this scheme, which possibly they have not used before simply because they were doubtful about its advantages

LECOMTE DU NOÜY

Institut Pasteur, Paris,
Feb 16

The Nature of the Virus Principle in Mosaic Disease

DURING the course of investigations designed to determine the nature of the infective principle present in the virus of tomato mosaic, a bacterial growth showing various forms was isolated Stained smears prepared from this showed so many bacteria in a state of breakdown that the phenomenon seemed worth examining further

The original isolations were prepared as follows Pieces of tomato stem taken from plants showing symptoms of mosaic disease and 'stripe' disease, were sterilised on the outside with calcium hypochlorite, and inserted into tubes of potato agar No growth resulted for ten weeks, but in the twelfth week three tubes showed a grey-brown bacterial growth on the agar round the piece of tomato tissue

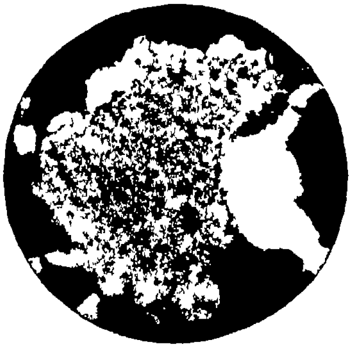


FIG 1

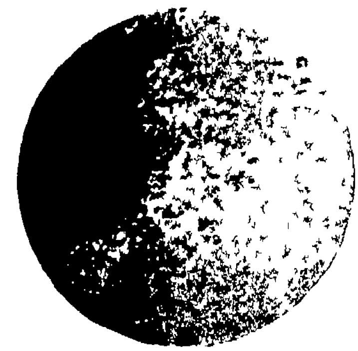


FIG 2

FIG 3

Stained smears showed small clear areas (Fig 1) at a magnification of 150 (In the reproduction, all the illustrations have been reduced to two-thirds of their original size.) When examined at a magnification of 1250 these areas appeared as in Fig. 2 The bacterial cells had been destroyed, leaving a granular deposit with deeply staining fragments strongly resembling minute organisms At other portions of the smears (Fig 3), certain cells were seen to be much swollen and speckled with minute darkly staining granules Cultures of the original growth were emulsified with water and filtered through a sterile Chamberland $L3$ filter When added to a broth culture of the original growth which had been freed so far as possible from 'phage', some slight clearing and diminution of the number of bacteria resulted

In view of the conditions under which the original isolations were obtained, it seemed possible that the bacteriophage principle present in the cultures might be the active virus of mosaic disease present in the tomato tissue from which the isolations were prepared

Consequently, a quantity of virus was extracted from a tomato plant originally inoculated with the virus of *Aucuba* mosaic disease, but which, since inoculation, had also developed symptoms of 'stripe' disease Portions of the virus which had passed through $L3$, $L5$, and $L7$ filters under aseptic conditions were tubed separately These were added in 1 c c lots to turbid potato broth cultures of the original growth which had been freed so far as possible from 'phage' In 24 hours, the tubes receiving filtrates from the $L3$ and $L5$ filters showed slight clearing, and in 48 hours, there was definite clearing of these tubes, and in some cases very slight clearing and browning where the filtrate from an $L7$ filter had been added Microscopic examination of drops from the cultures showed an appreciable diminution of bacterial numbers accompanied by apparent fragmentation when the filtrates from $L3$ and $L5$ filters were added Poured plates confirmed this observation

Potato broth tubes to which $L3$ filtrate of healthy tomato juice was added remained turbid, and neither decrease in the number of bacteria present nor change of form have been observed The action of the virus seems limited to certain organisms, for when added to mixed broth cultures prepared from soil and horse manure, no obvious clearing or browning resulted

In view of these results, which have been repeatedly obtained, it is suggested that the principle causing mosaic disease of the tomato is of the bacteriophage type, which, in the first place, enters the plant with the organism it parasitises in Nature and, becoming adapted to life within the tissues of the tomato plant, causes the symptoms now associated with mosaic disease

If this view be correct, its implications in the study of virus diseases are considerable

W F BEWLEY
Experimental and Research Station,
Cheshunt, Herts, Mar 5

Hardening of *Moti*, a Japanese Rice Food-stuff.

IN the course of my researches on the mechanism of the setting and hardening of cement, and on account of the similarity of the problems involved, I have investigated also the problem of the hardening of *moti*, a Japanese rice food-stuff Glutinous rice, previously steamed with special apparatus, is made into *moti* by pounding In the air, it hardens into a stone-like mass The results I have obtained so far are as follows

(1) The hardening phenomenon occurs in two ways: (*a*) It may be due to desiccation, that is, the water in the *moti* goes off into the air, the result being the formation of a stone like mass, or (*b*) it may be due to internal changes For example, when freshly prepared soft *moti* is preserved under paraffin, although desiccation is thus prevented, the *moti* hardens, but to a somewhat soft mass This mass hardens further on exposure to the air, cracking and forming a stone like mass

(2) By differential thermal analysis in a specially designed vessel, during both cooling and heating, *moti* shows at 63 5° C a transition point This change is reversible The transition point does not appear with freshly prepared *moti*, but it appears with *moti* which has been cooled once in a hermetically sealed vessel

(3) J R Katz (*Zeit physik Chem*, A, 150, 37, 1930, etc) suggested a transition point at about 60° C in the staling process of bread, and thinks the existence of this point is the cause of bread becoming stale So far as *moti* is concerned, this does not

hold good, although it has some relation to the cause of the hardening of *moti* referred to in (1) *Moti*, when once hardened, can begin to soften at a temperature somewhat below the transition point, and the water of *moti* is connected with its hardness These facts show that the constitution below and above the transition point is not the only factor in the determination of hardness

(4) My views (*J Phys Chem*, **31**, 933, 1927 *Zement*, **19**, 842, 1930) on the mechanism of the setting and hardening of cement are to a great extent applicable also to the hardening process of *moti* In brief, the hardening is due to the decrease of free water in the system In the case (1*a*) above, free water in *moti* escapes to the exterior In the case (1*b*), free water which exists at higher temperatures loses its freedom in cooling, becoming water of crystallisation, adsorbed water, etc It may be that the transition point 63 5° C is connected with the water of crystallisation As to the water of crystallisation in starch, the opinion of St v Naray Szabó (*Zeit physik Chem*, A, **151**, 420, 1930) is suggestive

Details of this work will appear in the *Scientific Papers* of this Institute

TUTOMU MAEDA

The Institute of Physical and Chemical Research,
Hongo Komagome, Tokyo,
Japan, Jan 31

Geo-electrical Prospecting.

IN my article published in NATURE of Jan 3 of this year, entitled "Geo electrical Prospecting by A C Bridge Methods", I stressed a disadvantage of the well-known A C equipotential line method of prospecting, which is sometimes so serious as to preclude the use of the method altogether The difficulty arises from the fact that large out of phase components occur in the neighbourhood of the more highly conducting ore-bodies and that in such circumstances it is impossible to locate equipotential points with any degree of accuracy In extreme cases there are no distinguishable minima from which the general trend of the current distribution may be determined

I am writing to direct attention to a means of overcoming this difficulty which was recently suggested to me by D C Gall, who at the time was visiting one of my field parties He proposed that a small search coil should be placed in series with the detecting circuit, which usually consists of a pair of pointed rods connected by 50 feet or so of wire to an amplifier and headphone Since the e m f induced in the coil will be in quadrature with the current, whereas that in the ground is approximately in phase with the current, it was to be expected that by suitably orientating the search coil it would be possible to balance the out-of-phase component and so locate the *in phase* equipotential points with precision

Mr Gall's suggestion has now been tried out and has proved most satisfactory, and there can be no doubt that it constitutes an improvement in the equipotential line method which will prove of great practical value In the tests recently carried out, the coil was permanently attached to the amplifier box on the back of the operator The latter, by slightly adjusting the position of his body, can quickly bring the coil into such a position that the equipotential points may be accurately located on the ground, complete silence being observed in the telephones

A BROUGHTON EDGE

Australia House,
Strand, London, W C 2,
Mar 17

Enumeration of Magic Squares of the 5th Order

A

25	8	5	24	3
7	16	9	14	19
6	11	13	15	20
4	12	17	10	22
23	18	21	2	1

B

25	21	2	7	10
17	1	22	16	9
14	18	13	8	12
3	20	4	15	23
6	5	24	19	11

C

15	18	6	12	14
16	1	22	21	5
8	20	11	3	23
9	2	19	25	10
17	24	7	4	13

In NATURE of Oct 17, 1925, p 573, I gave the above, but I was not then able to give the number of squares of *B* and *C* I can now complete this *A* has a 'Heart' magic in its 3 rows, 3 columns, and 2 diagonals, and with its 21 positions inside a square of 5th order has 649,168 squares *B* has a 'Heart' with only its 3 rows, 3 columns magic, and with its 21 positions of all proportions from 52/13–26/39 has 720,388 squares *C* has a 'Heart' without the number 13, and in its 18 positions has 3656 squares

Including all types of squares thus far, I have brought the grand total of magic squares of 5th order, whose 5 rows, 5 columns, and 2 diagonals are magic, to 1,623,768 One type only has one solitary square, but this type can be transformed by inversion into three other types, with their complementary squares of the proportion 52/13, each having a solitary square I give it as unique

9	5	25	12	14
10	13	19	3	20
7	8	16	11	23
24	17	1	21	2
15	22	4	18	6

Propn 26/39

J C BURNETT

Barkston,
Nr Grantham, Lincs,
Feb. 6.

Climatic Control in the Reproductive Cycle

IN my letter in NATURE of Feb. 7, p 200, entitled "Embryology and Evolution", I referred to a correlation between magnetic solar radiation and the reproduction of fur-bearing animals Statements to the effect that such a correlation has been proved to exist are frequent, and are also found in certain text-books, but there seems to be considerable doubt as to their validity

I have, therefore, sought to obtain reliable evidence on this subject, and I am indebted to the Governors and Committee of the Hudson's Bay Company, and to Mr Charles Elton, of Oxford, for information which is of value in showing that such a correlation was originally suggested by Mr Elton in 1924 as an *hypothesis* only, and that it has erroneously been elevated gradually by others to the rank of fact

I am informed by the Hudson's Bay Company that its trading operations are not based on the indications of sunspot activity nor on those of other meteorological conditions, while Mr Elton's view is that though sunspot influence *has to* be ruled out definitely, there is, nevertheless, some proof of climatic control in the reproduction cycle of fur bearers

The phenomenon of photoperiodicity in plants might well be substituted in my original argument as an example of an external control in the activities of the living cell

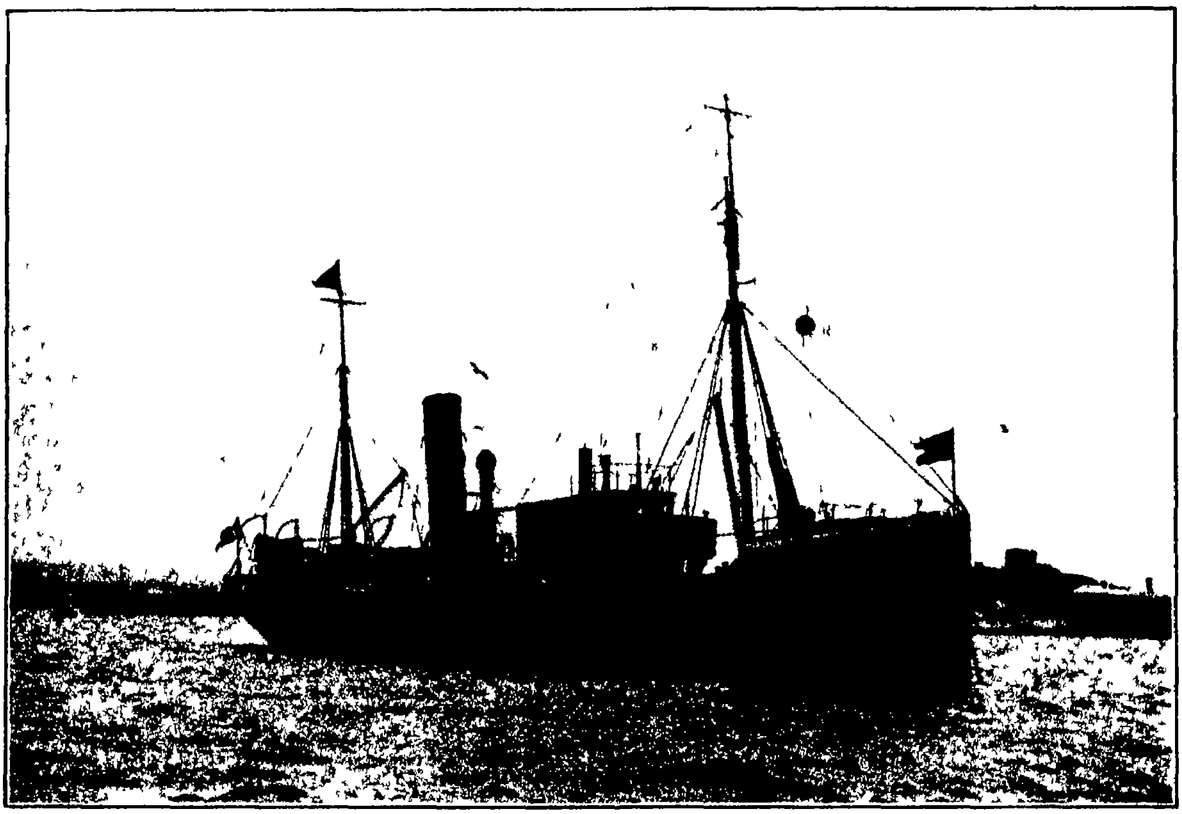
MALCOLM E MACGREGOR

Wellcome Field Laboratory,
Wisley, Surrey

Oceanographical Expedition of the *Dana*, 1928–1930

By Prof Johannes Schmidt, Ph D, D Sc,
Carlsberg Laboratory, Copenhagen, Leader of the Expedition

In Nature of Dec 29, 1928, Prof D'Arcy W Thompson gave an outline of the plans and scope of this expedition on board the Royal Danish Research Ship *Dana* This vessel, with its experienced master, Captain G Hansen, and staffed by officers of the Royal Navy, was placed at the disposal of the expedition by the Danish Government The cost of the expedition however, was defrayed by the Carlsberg Foundation, the largest scientific fund in Denmark, hence the official title "The Carlsberg Foundation's Oceanographical Expedition round the World 1928–30 under the Leadership of Professor Johannes Schmidt"



Photo] [The Times

Fig 1 —Royal Danish Research Ship *Dana* (360 tons) at anchor in Plymouth Roads June 21, 1930, on her return from the circumnavigation expedition

Prof D'Arcy Thompson has already noted in detail one of the main tasks of the expedition, namely, an investigation of the life-history of the Indo-Pacific fresh water eels (*Anguilla*), in similar fashion to the work I had already carried out in the case of the North Atlantic fresh water eels What I propose to do here is to give a brief account of the main points in the working methods and plans of the expedition, and then give two illustrations of the results, one drawn from the biological side, the other from the hydrographic side, the latter has been prepared by my colleague, Mr Helge Thomsen

Admiral H R H Prince Valdemar of Denmark was patron of the expedition, and it was controlled by a committee, the presidents of which were the late Prof C H Ostenfeld and Prof A B Drachmann, president of the Carlsberg Foundation, G C Amdrup, Vice-Admiral of the Royal Danish Navy, was vice-president of the committee

It was my good fortune to have among the scientific workers several colleagues from my earlier expeditions, the zoologists Dr P Jespersen, Dr Å V Tåning, and Mr A F Bruun, the physicists Dr J N Nielsen and Mr Helge Thomsen, and the botanist Prof Ove Paulsen, the botanist Mr E Nielsen also took part in the expedition Further, two Danish zoologists, Dr Th Mortensen and Dr R Spärck, spent some time on board engaged in bottom work, the former at St Helena and the Canaries, the latter in the Mediterranean

The expedition occupied two years The *Dana* left Copenhagen on June 14, 1928, and after circling the globe in a westerly direction, returned home on June 30, 1930 The total number of stations amounted to 661, and the distance covered was 65,000 miles, with a coal consumption of 3358 tons It should be mentioned that the

Dana, through her short-wave radio station, was in direct communication with the Copenhagen station during the whole expedition, even at the to those of the *Challenger* expedition, in which the pelagic collections played a more subordinate part

The most characteristic features of the working

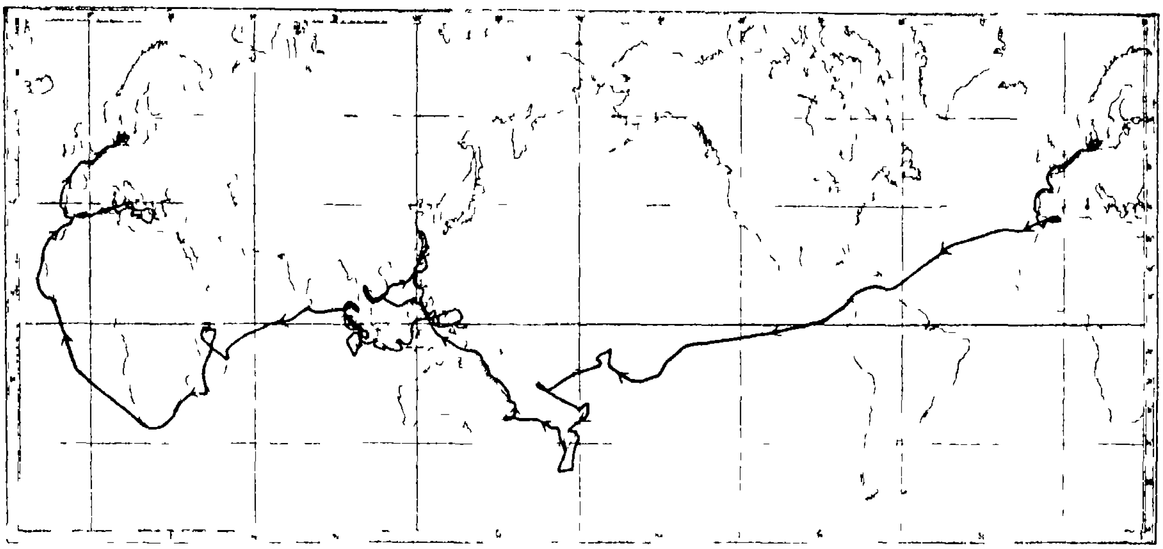


FIG 2 —Route of the *Dana* round the world June 14 1928–June 30 1930

antipodal region near New Zealand the communication was perfect

The route mapped with regard to the eel investigations was carried out almost completely according to plan, but owing to the limited coal capacity of our small vessel, we did not succeed in visiting all the regions in the Pacific and Indian Oceans that had been included in the scheme The chart (Fig 2) shows the course of the *Dana* round the world It ran in the main parallel with the equator, except in the western Pacific and on the last lap, where it turned vertical to the equator from the Cape of Good Hope homewards

The object of the expedition was not to bring home collections of zoological rareties The main general task was to study the distribution of the commonest oceanic species and genera in the three great oceans, and—having regard for the physical and chemical conditions under which they live—to seek some understanding of the factors concerned in this actual distribution and to make some contribution to their life-histories

Whilst the expedition of the *Dana's* great predecessor, the *Challenger*, was chiefly concerned with the investigation of the bottom and its fauna, our expedition was in special degree a pelagic expedition We investigated especially the upper and middle water layers and their inhabitants, and as we had the best pelagic fishing apparatus of the present time at our disposal, I venture to hope that our results will form, to a not inconsiderable extent, a supplement methods and plans of the *Dana* expedition may be summarised in three groups

1 With the aid of the most efficient apparatus, to obtain a very large material, rich in individuals, of the pelagic life in the different depths of the various oceans

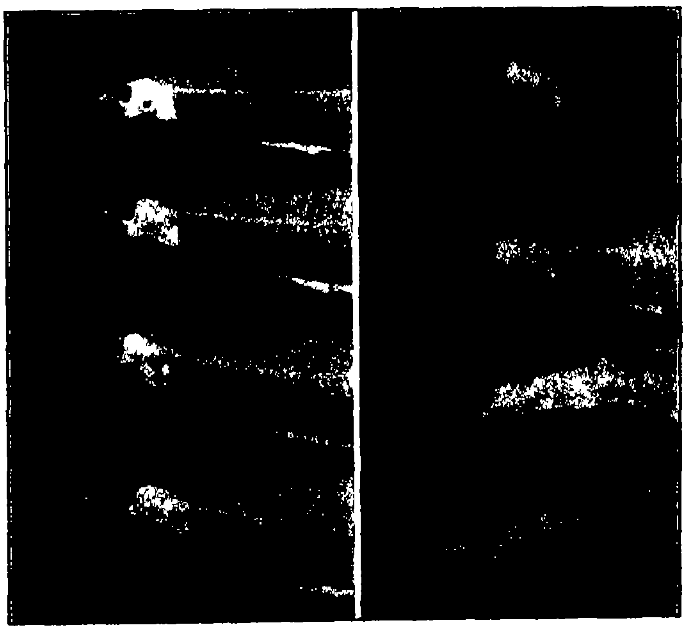


FIG 3 —Metamorphosis of *Nessorhamphus ingolfianus*, Johs Schmidt Specimens from the Sargasso Sea, showing transformation from the larval to the eel stage Photo A F Bruun

a Larval stage 67 mm
b Metamorphosis stage 71 mm
c „ „ 77 mm
d „ „ 82 mm
e Metamorphosis stage 84 mm
f „ „ 78 5 mm
g „ „ 83 mm
h „ „ 88 mm

2 With the aid of simultaneous, methodical

investigations on the physical and chemical composition of the different water layers, to obtain data which would permit us to conclude under what environmental conditions each single one of the millions of pelagic organisms, taken in our nets, may live

3 By means of the large pelagic material, which in numerical richness of the single species presumably surpasses that of earlier expeditions round the world, to subject a number of important oceanic species or genera to a finer analysis, with reference to classification, than has previously been possible with the frequently somewhat scanty material available from the distant waters To supplement the third point, I may add that the investigations of recent years, *inter alia* those especially of the fresh water eels, have shown that the treatment of the life history of a form (in part also of its distribution) must descend to the lowest systematic units But these units cannot be reached, as a rule, unless one has a large material of individuals, on which one can use biometric methods similar to those applied by Heincke and others to various northern food fishes, and which I have myself used for a number of years in the series of " Racial Investigations " published by the Carlsberg Laboratory since 1917

I nourish, therefore, the hope that our large and rich material from the three oceans, dealt with in this manner and from this point of view, may contribute new and important information regarding the species and genera of the pelagic fauna, their distribution in the oceans, their dependence on environmental conditions, and their life histories I refer here specially to the fishes which seem in marked degree suitable to biometric treatment, not least because the numerous larvæ can often be included in the investigation—several of the principal characters for the finer analysis, such as number of fin rays and especially vertebræ, being already fixed in the larval stage In addition, my assistants, several of whom took part in the expedition, are well acquainted with these investigations, each in his own group—I may mention here Dr Å V Tåning, whose work on the specifically and individually rich group of Scopelids has already won general recognition

The expedition's field of operations embraced not only the three oceans, but also many of the principal enclosed seas , Mediterranean, Caribbean, Banda, Celebes, Sulu and Mindanao, and the China Seas The following table summarises the number of the principal pelagic and hydrographical operations, etc , in the three oceans

	South Pacific	North Pacific	Indian Ocean	Atlantic
Horizontal hauls with large pelagic nets	606	377	1046	1034
Vertical hauls with silk nets	162	97	74	161
Deep sea water samples	1110	765	917	1383
Echo soundings	2025	896	2215	3064

It will naturally take some time before the large amount of material can be worked out fully, but a few examples of the results of the expedition may already be given

(*To be continued*)

Centenary of William Symington

By Eng Capt EDGAR C SMITH, O B E , R N

THE invention of the steam boat, or rather the application of the steam engine to the propulsion of vessels, the successful solution of which involved many problems, will always remain one of the great landmarks of human progress On no other single project of the same nature, perhaps, was time and thought, energy and wealth, expended so lavishly, and the recognition of the labours of its inventors is, therefore, a moral obligation Many of the projectors of steam navigation are known to us only by their patents or pamphlets, some are remembered for their ingenious suggestions and inventions, and a few by their persistent efforts to achieve what the majority of their fellows thought impracticable ' Crazy Rumsey " and Fulton's Folly " are but two of the epithets which remind us of the scepticism the pioneers had to face But neither derision nor opposition, failure nor disappointment, loss of health nor wealth, could stay the hand of progress There was always someone to step into the ranks to take the place of the fallen until the final goal was reached

" Generally what is usually called an invention ", said the late Sir Charles Parsons, " is the work of many individuals - each one adding something to the work of his predecessors " This was true only to a limited extent in the case of the steam boat, for the experiments of the Marquis de Jouffroy in France, of Fitch, Rumsey, Stevens, and Fulton in the United States, and of Miller, Symington, Stanhope, and Bell in Great Britain, were largely independent of each other Steam navigation as a regular means of transport is usually associated with the *Clermont* of Fulton and the *Comet* of Bell, built respectively in 1807 and 1812, but, as a matter of fact, the problem had already been completely solved in 1802 by Symington when he engined the *Charlotte Dundas*, and it was a cruel stroke of fate which robbed him of the fame which should have made him known as the ' father of steam navigation ' The machinery he placed in the *Charlotte Dundas* was not surpassed in simplicity and suitability for fifty years , it was far superior to that used by any of his predecessors, or even that supplied by the famous firm of Boulton and Watt for Fulton's *Clermont* If, therefore, he is denied the title of the ' father of steam navigation ', no one can withhold from him the name of the ' father of marine engineering '

Symington, the centenary of whose death occurs on Mar 22, was born in the mining village of Lead-

(*Continued on p* 455)

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The End of the World from the Standpoint of Mathematical Physics.*

By Sir ARTHUR S EDDINGTON, F R S

THE world—or space-time—is a four dimensional continuum, and consequently offers a choice of a great many directions in which we might start off to look for an end, and it is by no means easy to describe "from the standpoint of mathematical physics" the direction in which I intend to go I have therefore to examine at some length the preliminary question, Which end ?

SPHERICAL SPACE

We no longer look for an end to the world in its space dimensions We have reason to believe that so far as its space dimensions are concerned the world is of spherical type If we proceed in any direction in space we do not come to an end of space, nor do we continue on to infinity, but, after travelling a certain distance (not inconceivably great), we find ourselves back at our starting point, having 'gone round the world' A continuum with this property is said to be finite but unbounded The surface of a sphere is an example of a finite but unbounded two dimensional continuum, our actual three dimensional space is believed to have the same kind of connectivity, but naturally the extra dimension makes it more difficult to picture If we attempt to picture spherical space, we have to keep in mind that it is the *surface* of the sphere that is the analogue of our three-dimensional space, the inside and the outside of the sphere are fictitious elements in the picture which have no analogue in the actual world

We have recently learnt, mainly through the work of Prof Lemaître, that this spherical space is expanding rather rapidly In fact, if we wish to travel round the world and get back to our starting point, we shall have to move faster than light, because, whilst we are loitering on the way, the track ahead of us is lengthening It is like trying to run a race in which the finishing tape is moving ahead faster than the runners We can picture the stars and galaxies as embedded in the surface of a rubber balloon which is being steadily inflated, so that, apart from their individual motions and the effects of their ordinary gravitational attraction on one another, celestial objects are becoming farther and farther apart simply by the inflation It is probable that the spiral nebulæ are so distant that they are very little affected by mutual gravitation and exhibit the inflation effect in its pure form It has been known for some years that they are scattering apart rather rapidly, and we accept their measured rate of recession as a determination of the rate of expansion of the world

From the astronomical data it appears that the original radius of space was 1200 million light years Remembering that distances of celestial objects up to several million light years have actually been measured, that does not seem overwhelmingly great At that radius the mutual attraction of the matter in the world was just sufficient to hold it together and check the tendency to expand But this equilibrium was unstable An expansion began, slow at first, but the more widely the matter was scattered the less able was the mutual gravitation to check the expansion We do not know the radius of space to-day, but I should estimate that it is not less than ten times the original radius

At present our numerical results depend on astronomical observations of the speed of scattering apart of the spiral nebulæ But I believe that theory is well on the way to obtaining the same results independently of astronomical observation. Out of the recession of the spiral nebulæ we can determine not only the original radius of the universe but also the total mass of the universe,

* Presidential address to the Mathematical Association, delivered on Jan. 5.

and hence the total number of protons in the world I find this number to be either 7×10^{78} or 14×10^{78} * I believe that this number is very closely connected with the ratio of the electrostatic and the gravitational units of force, and, apart from a numerical coefficient, is equal to the square of the ratio If F is the ratio of the electrical attraction between a proton and electron to their gravitational attraction, we find $F^2 = 5.3 \times 10^{78}$ There are theoretical reasons for believing that the total number of particles in the world is aF^2, where a is a simple geometrical factor (perhaps involving π) It ought to be possible before long to find a theoretical value of a, and so make a complete connexion between the observed rate of expansion of the universe and the ratio of electrical and gravitational forces

Signposts for Time

I must not dally over space any longer but must turn to time The world is closed in its space dimensions but is open in both directions in its time dimension Proceeding from 'here' in any direction in space we ultimately come back to 'here', but proceeding from 'now' towards the future or the past we shall never come across 'now' again There is no bending round of time to bring us back to the moment we started from In mathematics this difference is provided for by the symbol $\sqrt{-1}$, just as the same symbol crops up in distinguishing a closed ellipse and an open hyperbola

If, then, we are looking for an end of the world—or, instead of an end, an indefinite continuation for ever and ever—we must start off in one of the two time directions How shall we decide which of these two directions to take? It is an important question Imagine yourself in some unfamiliar part of space time so as not to be biased by conventional landmarks or traditional standards of reference There ought to be a signpost with one arm marked 'To the future' and the other arm marked 'To the past' My first business is to find this signpost, for if I make a mistake and go the wrong way I shall lead you to what is no doubt an 'end of the world', but it will be that end which is more usually described as the *beginning*

In ordinary life the signpost is provided by consciousness Or perhaps it would be truer to say that consciousness does not bother about signposts, but wherever it finds itself it goes off on urgent business in a particular direction, and the physicist meekly accepts its lead and labels the course it takes 'To the future' It is an important question whether consciousness in selecting its direction is guided by anything in the physical world If it is guided, we ought to be able to find directly what it is in the physical world which makes it a one way street for conscious beings The view is sometimes held that the 'going on of time' *does not exist in the physical world* at all and is a purely subjective impression According to that view, the difference between past and future in the material universe has no more significance than the difference between right and left The fact that experience presents space time as a cinematograph film which is always unrolled in a particular direction is not a property or peculiarity of the film (that is, the physical world) but of the way it is inserted into the cinematograph (that is, consciousness) In fact, the one-way traffic in time arises from the way our material bodies are geared on to our consciousness

> "Nature has made our gears in such a way
> That we can never get into reverse"

If this view is right, 'the going on of time' should be dropped out of our picture of the physical universe Just as we have dropped the old geocentric outlook and other idiosyncrasies of our circumstances as observers, so we must drop the dynamic presentation of events which is no part of the universe itself but is introduced in our peculiar mode of apprehending it In particular, we must be careful not to treat a past to-future presentation of events as truer or more significant than a future to-past presentation We must, of course, drop the theory of evolution, or at least set alongside it a theory of anti evolution as equally significant

If anyone holds this view, I have no argument to bring against him I can only say to him, "You are a teacher whose duty it is to inculcate in youthful minds a true and balanced outlook But you teach (or without protest allow your colleagues to teach) the utterly one-sided doctrine of evolution You teach it not as a colourless schedule of facts but as though there were something significant, perhaps even morally inspiring, in the progress from formless chaos to perfected adaptation This is dishonest, you should also treat it from the equally significant point of view of anti-evolution and discourse on the progress from future to past Show how from the diverse forms of life existing to-day Nature anti-evolved forms which were more and more unfitted to survive, until she reached the sublime crudity of the palæozoic forms Show

* This ambiguity is inseparable from the operation of counting the number of particles in finite but unbounded space It is impossible to tell whether the protons have been counted once or twice over

how from the solar system Nature and evolved a chaotic nebula. Show how, in the course of progress from future to past, Nature took a universe which, with all its faults, is not such a bad effort of architecture and—in short, made a hash of it."

Entropy and Disorganisation

Leaving aside the guidance of consciousness, we have found it possible to discover a kind of signpost for time in the physical world. The signpost is of rather a curious character, and I would scarcely venture to say that the discovery of the signpost amounts to the same thing as the discovery of an objective 'going on of time' in the universe. But at any rate it serves to discriminate past and future, whereas there is no corresponding objective distinction of left and right. *The distinction is provided* by a certain measurable quantity called entropy. Take an isolated system and measure its entropy S at two instants t_1 and t_2. We want to know whether t_1 is earlier or later than t_2 without employing the intuition of consciousness, which is too disreputable a witness to trust in mathematical physics. The rule is that the instant which corresponds to the greater entropy is the later. In mathematical form

dS/dt is always positive.

This is the famous second law of thermodynamics.

Entropy is a very peculiar conception, quite unlike the conceptions ordinarily employed in the classical scheme of physics. We may most conveniently describe it as the measure of disorganisation of a system. Accordingly, our signpost for time resolves itself into the law that disorganisation increases from past to future. It is one of the most curious features of the development of physics that the entropy outlook grew up quietly alongside the ordinary analytical outlook for a great many years. Until recently it always 'played second fiddle'; it was convenient for getting practical results, but it did not pretend to convey the most penetrating insight. But now it is making a bid for supremacy, and I think there is little doubt that it will ultimately drive out its rival.

There are some important points to emphasise. First, there is no other independent signpost for time; so that if we discredit or 'explain away' this property of entropy, the distinction of past and future in the physical world will disappear altogether. Secondly, the test works consistently; isolated systems in different parts of the universe agree in giving the same direction of time. Thirdly, in applying the test we must make certain that our system is strictly isolated. Evolution teaches us that more and more highly organised systems develop as time goes on; but this does not contradict the conclusion that on the whole there is a loss of organisation. It is partly a question of definition of organisation; from the evolutionary point of view it is quality rather than quantity of organisation that is noticed. But, in any case, the high organisation of these systems is obtained by draining organisation from other systems with which they come in contact. A human being as he grows from past to future becomes more and more highly organised—at least, he fondly imagines so. But if we make an isolated system of him, that is to say, if we cut off his supply of food and drink and air, he speedily attains a state which everyone would recognise as 'a state of disorganisation'.

It is possible for the disorganisation of a system to become complete. The state then reached is called thermodynamic equilibrium. The entropy can increase no further, and, since the second law of thermodynamics forbids a decrease, it remains constant. Our signpost for time disappears; and so far as that system is concerned, time ceases to go on. That does not mean that time ceases to exist; it exists and extends just as space exists and extends, but there is no longer any one-way property. It is like a one-way street on which there is never any traffic.

Let us return to our signpost. Ahead there is ever-increasing disorganisation. Although the sum total of organisation is diminishing, certain parts of the universe are exhibiting a more and more highly specialised organisation; that is the phenomenon of evolution. But ultimately this must be swallowed up in the advancing tide of chance and chaos, and the whole universe will reach a state of complete disorganisation—a uniform featureless mass in thermodynamic equilibrium. This is the end of the world. Time will *extend* on and on, presumably to infinity. But there will be no definable sense in which it can be said to *go* on. Consciousness will obviously have disappeared from the physical world before thermodynamical equilibrium is reached, and dS/dt having vanished, there will remain nothing to point out a direction in time.

The Beginning of Time

It is more interesting to look in the opposite direction—towards the past. Following time backwards, we find more and more organisation in the world. If we are not stopped earlier, we must

come to a time when the matter and energy of the world had the maximum possible organisation. To go back further is impossible. We have come to an abrupt end of space-time—only we generally call it the 'beginning.'

I have no 'philosophical axe to grind' in this discussion. Philosophically, the notion of a beginning of the present order of Nature is repugnant to me. I am simply stating the dilemma to which our present fundamental conception of physical law leads us. I see no way round it; but whether future developments of science will find an escape I cannot predict. The dilemma is this:—Surveying our surroundings, we find them to be far from a 'fortuitous concourse of atoms.' The picture of the world, as drawn in existing physical theories, shows arrangement of the individual elements for which the odds are multillions* to 1 against an origin by chance. Some people would like to call this non-random feature of the world purpose or design; but I will call it non-committally anti-chance. We are unwilling to admit in physics that anti-chance plays any part in the reactions between the systems of billions of atoms and quanta that we study; and indeed all our experimental evidence goes to show that these are governed by the laws of chance. Accordingly, we sweep anti-chance out of the laws of physics—out of the differential equations. Naturally, therefore, it reappears in the boundary conditions, for it must be got into the scheme somewhere. By sweeping it far enough away from the sphere of our current physical problems, we fancy we have got rid of it. It is only when some of us are so misguided as to try to get back billions of years into the past that we find the sweepings all piled up like a high wall and forming a boundary—a beginning of time—which we cannot climb over.

A way out of the dilemma has been proposed which seems to have found favour with a number of scientific workers. I oppose it because I think it is untenable, not because of any desire to retain the present dilemma. I should like to find a genuine loophole. But that does not alter my conviction that the loophole that is at present being advocated is a blind alley. I must first deal with a minor criticism.

I have sometimes been taken to task for not sufficiently emphasising in my discussion of these problems that the results about entropy are a matter of probability, not of certainty. I said above that if we observe a system at two instants, the instant corresponding to the greater entropy will be the later. Strictly speaking, I ought to have said that for a smallish system the chances are, say, 10^{20} to 1, that it is the later. Some critics seem to have been shocked at my lax morality in making such a statement, when I was well aware of the 1 in 10^{20} chance of its being wrong. Let me make a confession. I have in the past twenty-five years written a good many papers and books, broadcasting a large number of statements about the physical world. I fear that for not many of these statements is the risk of error so small as 1 in 10^{20}. Except in the domain of pure mathematics, the trustworthiness of my conclusions is usually to be rated at nearer 10 to 1 than 10^{20} to 1; even that may be unduly boastful. I do not think it would be for the benefit of the world that no statement should be allowed to be made if there were a 1 in 10^{20} chance of its being untrue; conversation would languish somewhat. The only persons entitled to open their mouths would presumably be the pure mathematicians.

Fluctuations

The loophole to which I referred depends on the occurrence of chance fluctuations. If we have a number of particles moving about at random, they will in the course of time go through every possible configuration, so that even the most orderly, the most non-chance configuration, will occur by chance if only we wait long enough. When the world has reached complete disorganisation (thermodynamic equilibrium) there is still infinite time ahead of it, and its elements will thus have opportunity to take up every possible configuration again and again. If we wait long enough, a number of atoms will, just by chance, arrange themselves in systems as they are at present arranged in this room; and, just by chance, the same sound-waves will come from one of these systems of atoms as are at present emerging from my lips; they will strike the ears of other systems of atoms, arranged just by chance to resemble you, and in the same stages of attention or somnolence. This mock Mathematical Association meeting must be repeated many times over—an infinite number of times, in fact—before t reaches $+\infty$. Do not ask me whether I expect you to believe that this will really happen.†

"Logic is logic. That's all I say."

So, after the world has reached thermodynamical equilibrium the entropy remains steady at its

* I use "multillions" as a general term for numbers of order $10^{10^{10}}$ or larger.

† I am hopeful that the doctrine of the "expanding universe" will intervene to prevent its happening.

maximum value, except that 'once in a blue moon' the absurdly small chance comes off and the entropy drops appreciably below its maximum value. When this fluctuation has died out, there will again be a very long wait for another coincidence giving another fluctuation. It will take multillions of years, but we have all infinity of time before us. There is no limit to the amount of the fluctuation, and if we wait long enough we shall come across a big fluctuation which will take the world as far from thermodynamical equilibrium as it is at the present moment. If we wait for an enormously longer time, during which this huge fluctuation is repeated untold numbers of times, there will occur a still larger fluctuation which will take the world as far from thermodynamical equilibrium as it was one second ago.

The suggestion is that we are now on the downward slope of one of these fluctuations. It has quite a pleasant subtlety. Is it chance that we happen to be running down the slope and not toiling up the slope? Not at all. So far as the physical universe is concerned, we have *defined* the direction of time as the direction from greater to less organisation, so that, on whichever side of the mountain we stand, our signpost will point downhill. In fact, on this theory, the going on of time is not a property of time in general, but is a property of the slope of the fluctuation on which we are standing. Again, although the theory postulates a universe involving an extremely improbable coincidence, it provides an infinite time during which the most improbable coincidence might occur. Nevertheless, I feel sure that the argument is fallacious.

If we put a kettle of water on the fire there is a chance that the water will freeze. If mankind goes on putting kettles on the fire until $t=\infty$, the chance will one day come off and the individual concerned will be somewhat surprised to find a lump of ice in his kettle. But it will not happen to *me*. Even if to-morrow the phenomenon occurs before my eyes, I shall not explain it this way. I would much sooner believe in interference by a demon than in a coincidence of that kind coming off; and in doing so I shall be acting as a rational scientist. The reason why I do not at present believe that devils interfere with my cooking arrangements and other business, is because I have become convinced by experience that Nature obeys certain uniformities which we call laws. I am convinced because these laws have been tested over and over again. But it is possible that every single observation from the beginning of science which has been used as a test, has just happened to fit in with the law by a chance coincidence. It would be an improbable coincidence, but I think not quite so improbable as the coincidence involved in my kettle of water freezing. So if the event happens and I can think of no other explanation, I shall have to choose between two highly improbable coincidences: (*a*) that there are no laws of Nature and that the apparent uniformities so far observed are merely coincidences; (*b*) that the event is entirely in accordance with the accepted laws of Nature, but that an improbable coincidence has happened. I choose the former because mathematical calculation indicates that it is the less improbable. I reckon a sufficiently improbable coincidence as something much more disastrous than a violation of the laws of Nature; because my whole reason for accepting the laws of Nature rests on the assumption that improbable coincidences do not happen—at least, that they do not happen in my experience.*

Similarly, if logic predicts that a mock meeting of the Mathematical Association will occur just by a fortuitous arrangement of atoms before $t=\infty$, I reply that I cannot possibly accept that as being the explanation of a meeting of the Mathematical Association in $t=1931$. We must be a little careful over this, because there is a trap for the unwary. The year 1931 is not an absolutely random date between $t=-\infty$ and $t=+\infty$. We must not argue that because for only $1/x$th of time between $t=-\infty$ and $t=\infty$ a fluctuation as great as the present one is in operation, therefore the chances are x to 1 against such a fluctuation occurring in the year 1931. For the purposes of the present discussion, the important characteristic of the year 1931 is that it belongs to a period during which there exist in the universe beings capable of speculating about the universe and its fluctuations. Now I think it is clear that such creatures could not exist in a universe in thermodynamical equilibrium. A considerable degree of deviation is required to permit of living beings. Therefore it is perfectly fair for supporters of this suggestion to wipe out of account all those multillions of years during which the fluctuations are less than the minimum required to permit of the development and existence of mathematical physicists. That greatly diminishes x, but the odds are still overpowering. The *crude* assertion would be that (unless we admit something which is not chance in the architecture of the universe) it is practically certain that at any assigned date the universe will be almost in the state of

* No doubt "extremely improbable" coincidences occur to all of us, but the improbability is of an utterly different order of magnitude from that concerned in the present discussion.

maximum disorganisation. The *amended* assertion is that (unless we admit something which is not chance in the architecture of the universe) it is practically certain that a universe containing mathematical physicists will at any assigned date be in the state of maximum disorganisation which is not inconsistent with the existence of such creatures. I think it is quite clear that neither the original nor the amended version applies. We are thus driven to admit anti-chance; and apparently the best thing we can do with it is to sweep it up into a heap at the beginning of time, as I have already described.

The connexion between our entropy signpost and that dynamic quality of time which we describe as 'going on' or 'becoming' leads to very difficult questions which I cannot discuss here. The puzzle is that the signpost seems so utterly different from the thing of which it is supposed to be the sign. The one thing on which I have to insist is that, apart from consciousness, the increase of entropy is the only trace that we can find of a one-way direction of time. I was once asked a ribald question: How does an electron (which has not the resource of consciousness) remember which way time is going? Why should it not inadvertently turn round and, so to speak, face time the other way? Does it have to calculate which way entropy is increasing in order to keep itself straight? I am inclined to think that an electron does do something of that sort. For an electric charge to face the opposite way in time is the same thing as to change the sign of the charge. So if an electron mistook the way time was going it would turn into a positive charge. Now, it has been one of the troubles of Dr. P. A. M. Dirac that in the mathematical calculations based on his wave equation the electrons do sometimes forget themselves in this way. As he puts it, there is a finite chance of the charge changing sign after an encounter. You must understand that they only do this in the mathematical problems, not in real life. It seems to me there is good reason for this. A mathematical problem deals with, say, four electric charges at the most; that is about as many as a calculator would care to take on. Accordingly, the unfortunate electron in the problem has to make out the direction of past to future by watching the organisation of three other charges. Naturally, it is deceived sometimes by chance coincidences which may easily happen when there are only three particles concerned; and so it has a good chance of facing the wrong way and becoming a positive charge. But in any real experiment we work with apparatus containing billions of particles—ample to give the electron its bearings with certainty. Dirac's theory predicts things which never happen, simply because it is applied to problems which never occur in Nature. When it is applied to four particles alone in the universe, the analysis very properly brings out the fact that in such a system there could be no steady one-way direction of time, and vagaries would occur which are guarded against in our actual universe consisting of about 10^{79} particles.

Heisenberg's Principle

A discussion of the properties of time would be incomplete without a reference to the principle of indeterminacy, which was formulated by Heisenberg in 1927 and has been generally accepted. It had already been realised that theoretical physics was drifting away from a deterministic basis; Heisenberg's principle delivered the knock-out blow, for it actually postulated a certain measure of indeterminacy or unpredictability of the future as a fundamental law of the universe. This change of view seems to make the progress of time a much more genuine thing than it used to be in classical physics. Each passing moment brings into the world something new—something which is not merely a mathematical extrapolation of what was already there.

The deterministic view which held sway for at least two centuries was that if we had complete data as to the state of the whole universe during, say, the first minute of the year 1600, it would be merely a mathematical exercise to deduce everything that has happened or will happen at any date in the future or past. The future would be determined by the present as the solution of a differential equation is determined by the boundary conditions. To understand the new view, it is necessary to realise that there is a risk of begging the question when we use the phrase 'complete data'. All our knowledge of the physical world is inferential. I have no direct acquaintance with my pen as an object in the physical world; I infer its existence and properties from the light waves which fall on my eyes, the pressure waves which travel up my muscles, and so on.

Precisely the same scheme of inference leads us to infer the existence of things in the past. Just as I infer a physical object, namely, my pen, as the cause of certain visual sensations now, so I may infer an infection some days ago as the cause of an attack of measles. If we follow out this principle completely we shall infer causes in the year 1600

for all the events which we know to have happened in 1930. At first sight it would seem that these inferred causes have just as much status in the physical world as my fountain pen, which is likewise an inferred cause. So the determinist thinks he has me in a cleft stick. If the scientific worker poking about in the universe in 1600 comes across these causes, then he has all the data for making a correct prediction for 1930; if he does not, then he clearly has not complete knowledge of the universe in 1600, for these causes have as much right to the status of physical entities as any of our other inferences.

I need scarcely stop to show how this begs the question by arbitrarily prescribing what we should deem to be complete knowledge of the universe in 1600, irrespective of whether there is any conceivable way in which this knowledge could be obtained at the time. What Heisenberg discovered was that (at least in a wide range of phenomena embracing the whole of atomic physics and electron theory) there is a provision of Nature that just half of the data demanded by our determinist friend might with sufficient diligence be collected by the investigators in 1600, and that complete knowledge of this half would automatically exclude all knowledge of the other half. It is an odd arrangement, because you can take your choice which half you will find out; you can know either half but not both halves. Or you can make a compromise and know both halves imperfectly, that is, with some margin of uncertainty. But the rule is definite. The data are linked in pairs and the more accurately you measure one member of the pair the less accurately you can measure the other member.

Both halves are necessary for a complete prediction of the future, although, of course, by judiciously choosing the type of event we predict we can often make safe prophecies. For example, the principle of indeterminacy will obviously not interfere with my prediction that during the coming year zero will turn up approximately $\frac{1}{37}$ of the total number of times the roulette ball is spun at Monte Carlo. All our successful predictions in physics and astronomy are on examination found to depend on this device of eliminating the inherent uncertainty of the future by averaging.

As an illustration, let us consider the simplest type of prediction. Suppose we have a particle, say an electron, moving undisturbed with uniform velocity. If we know its position now and its velocity, it is a simple matter to predict its position at some particular future instant. Heisenberg's principle asserts that the position and velocity are paired data; that is to say, although there is no limit to the accuracy with which we might get to know the position and no limit to the accuracy with which we might get to know the velocity, we cannot get to know both. So our attempt at an accurate prediction of the future position of the particle is frustrated. We can, if we like, observe the position now and the position at the future instant with the utmost accuracy (since these are not paired data) and then calculate what has been the velocity in the meantime. Suppose that we use this velocity together with the original position to compute the second position. Our result will be quite correct, and we shall be true prophets—after the event.

This principle is so fully incorporated into modern physics that in wave mechanics the electron is actually pictured in a way which exhibits this 'interference' of position and velocity. To attribute to it exact position and velocity simultaneously would be inconsistent with the picture. Thus, according to our present outlook, the absence of one half of the data of prediction is not to be counted as ignorance; the data are lacking because they do not come into the world until it is too late to make the prediction. They come into existence when the event is accomplished.

I suppose that to justify my title I ought to conclude with a prophecy as to what the end of the world will be like. I confess I am not very keen on the task. I half thought of taking refuge in the excuse that, having just explained that the future is unpredictable, I ought not to be expected to predict it. But I am afraid that someone would point out that the excuse is a thin one, because all that is required is a computation of averages and that type of prediction is not forbidden by the principle of indeterminacy. It used to be thought that in the end all the matter of the universe would collect into one rather dense ball at uniform temperature; but the doctrine of spherical space, and more especially the recent results as to the expansion of the universe, have changed that. There are one or two unsettled points which prevent a definite conclusion, so I will content myself with stating one of several possibilities. It is widely thought that matter slowly changes into radiation. If so, it would seem that the universe will ultimately become a ball of radiation growing ever larger, the radiation becoming thinner and passing into longer and longer wavelengths. About every 1500 million years it will double its radius, and its size will go on expanding in this way in geometrical progression for ever.

Science and Prediction

"PROPHECY", we are told, "is the most gratuitous of all forms of error", and long-distance forecasts have a way of going wrong, even when apparently firmly based upon all the available knowledge of the time Thus, Sir William Crookes predicted a world shortage of wheat for the present age, when in fact (owing to the unexpected success of science in fixing atmospheric nitrogen and making new fertilisers) there is an embarrassing surplus The real justification for making such forecasts is not that they are likely to be realised, but that they throw light upon the state of contemporary science, and may indicate where it requires supplementing This may be exemplified from the address of Sir Arthur Eddington presented in the present supplement

Before analysing Sir Arthur's basis of predictions concerning the end of the world, we may briefly consider earlier discussions of this topic At one time, such speculations had a theological basis, and often predicted a very unequal distribution of temperature, which in some regions would be excessively high In the nineteenth century, these were replaced by considerations concerning the loss of heat by the earth and the sun The earth was apparently cooling so rapidly as to leave insufficient time for biological evolution, and in a comparatively short time (from the evolutionary point of view) both earth and sun seemed doomed to experience a temperature which would be uniform and excessively low However, the date of this predicted catastrophe had to be put forward about a billion and a half years when radioactivity was discovered, for it revealed immense quantities of stored up atomic energy which could be changed into heat Another postponement was necessitated by the discovery of the convertibility of mass and radiation This gave the sun an enormously increased lifetime A period at least a hundred times more remote than before was offered by the astronomer's suggestion that in the interior of heavy atoms an electron may combine with a proton and release energy by their mutual annihilation But all this merely put off the evil day when a dying earth should at last fall into a dying sun and the whole universe, ever contracting, finally collapse in a single heap Sir Arthur Eddington, taking as his basis the second law of thermodynamics and recent developments of the cosmological theory of relativity, adopts the prediction as to the ultimate uniformity and lowness of temperature, but declares the universe to be expanding instead of contracting Possibly it will become a ball of radiation which doubles its size every 1500 million years, growing ever more and more attenuated

Let us consider the evidence for the physical laws underlying these predictions The cosmological theory of relativity may be considered as having arisen from the attempt to make the boundary conditions, as well as the differential equations expressing physical laws, independent of the choice of co ordinates Einstein in 1917 accomplished this by the drastic method of abolishing the boundary, and postulating a universe which was finite though unbounded (the analogue of the finite but unbounded surface of a sphere) An alternative theory was given by de Sitter, but, as was pointed out by Sir Arthur Eddington, neither of these theories could be accepted as corresponding to physical realities One contained matter but no motion, and the other motion but no matter No further progress was made for about ten years, when Lemaître obtained a new solution of the relativity equations This corresponded to an expanding universe, and it was afterwards shown that Einstein's and de Sitter's theories were limiting cases of this, one at the beginning of the motion and the other at the end, probably both unattainable The strong point of Lemaître's theory is that it offers an explanation of the observed redness of the spectra of many nebulæ, which is generally taken to mean that they are moving away from us at enormous speeds But it must not be forgotten that other explanations of this redness are possible Lemaître's cosmological theory holds the field for the present, but it is far from being thoroughly tested

The second law of thermodynamics is on a different footing Nothing seems better established than that it is impossible for a self acting system, unaided by an external agency, to convey heat from one body to another at a higher temperature Yet even here doubt may be felt as to whether this is without exception Millikan tells us that the intensely cold regions in the depths of interstellar space are the source of a very penetrating radiation, known as the cosmic rays These seem to be due to the building up of the more complex elements out of hydrogen In other words, the processes of disintegration and decay which are taking place elsewhere appear to be reversed here Let us not be too sure that the universe is like a watch that is always running down, there may be a rewinding The process of creation may not yet be finished

H. T. H. PIAGGIO.

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hills, Lanarkshire, in 1763 Given a good education, he became a student in Black's classes at the University of Edinburgh, but following in his father's footsteps, he entered the service of the Wanlockhead Mining Company near Leadhills Familiar with the steam engines of Newcomen and Watt, in 1786 he made a model steam carriage and in 1787 took out a patent for a new form of steam engine Through this he was brought into contact with Patrick Miller, the banker, who was desirous of trying a steam engine in one of the double-hulled boats with which he was experimenting To meet Miller's wishes, Symington constructed an engine with cylinders 4 in in diameter, which in October 1788 drove one of Miller's boats across the little Dalswinton Loch in Dumfriesshire at 4-5 miles an hour Next year a larger boat and a larger engine were experimented with, but the results were not very satisfactory and the matter was not pursued further The engine of 1788 happily was preserved and can be seen in the Science Museum, South Kensington It is the oldest marine engine in existence, and there are few older steam engines of any kind

The experiments of Miller and Symington had been preceded by those of Rumsey on the Potomac and of Fitch on the Delaware, and Fitch was the first in the world to form a steam boat company and to carry passengers His company, it is true, had but a short life, but from then onwards to the end of the eighteenth century there was probably never a time when one or other of the steam boat pioneers was not at work Symington's second opportunity came in 1801, when Thomas, Lord Dundas of Kerse, a governor of the Forth and Clyde Canal Company, instructed him to build a steam boat for use on the Canal The hull was constructed by Hart, of Grangemouth, and the *Charlotte Dundas*, as the boat was called, was 56 ft long and 18 ft wide There was a recess in the stern for a paddle wheel, the boiler was placed aft on the starboard side, and the engine on the port side To the uninitiated, the engine of 1788 might appear to have required more ingenuity to design than that of 1801 It is certainly far more complicated, but this was partly due to the steps Symington had to take to avoid the ramifications of Watt's patents which were in force In 1801 those patents had expired, and, free to use the ideas of his predecessors and to combine these in any way he thought best, Symington was able to construct an engine for the *Charlotte Dundas* which would almost meet modern requirements The engine was double-acting with one cylinder, and the piston rod drove the crank shaft of the paddle wheel direct through a crosshead and a connecting rod The air pump and condenser were placed below the cylinder, the former being worked by a bell crank lever

The running of the *Charlotte Dundas* quickly proved that Symington had produced a reliable and powerful engine, and the capacity of the boat was shown by her successfully towing two vessels of 70 tons each a distance of 19½ miles Convinced of the utility of the boat, Lord Dundas introduced Symington to the Duke of Bridgewater, who without much hesitation decided to adopt vessels similar to the *Charlotte Dundas* for the Bridgewater Canal and ordered the construction of eight steam boats Had the Duke lived but another year, there is little doubt that the boats would have been built and that to-day we should date the birth of steam navigation from the *Charlotte Dundas* and not from the *Clermont* and the *Comet* The Duke's death in 1803, however, led to the cancellation of the order, and about the same time the owners of the Forth and Clyde Canal, afraid of the effects of the wash caused by the *Charlotte Dundas*, laid her up on the mud near Bainsford Drawbridge, which became her grave She was never used again, and engine and hull alike have long since been destroyed

This proved the turning point in Symington's career and he never recovered from the disastrous set back to his fortunes When more than sixty years of age, he sought assistance from the Government and was granted two small sums, of £100 and £50 His death took place in London on Mar 22, 1831, and three days later he was buried in the churchyard of St Botolph, Aldgate His grave never bore a stone, but in 1903 a tablet to his memory was placed in the church by the late Lord Bearsted, who was then Sir Marcus Samuel and Lord Mayor of London A marble bust of Symington was unveiled in the Royal Scottish Museum in 1890 by Lord Kelvin

Though in his day neglected, Symington to-day is recognised as the designer of the first practical steam boat, and at the request of the Institute of Marine Engineers and the Newcomen Society, the vicar of St Botolph, Aldgate, has arranged to hold a special service to commemorate the centenary of his death This service will take place at 11 A M on Sunday, Mar 22, the hundredth anniversary of Symington's death, and an address on Symington's work will be given by Engineer Vice-Admiral Sir Robert Dixon

Obituary

MR H HARRIES

WITH the death of Mr Henry Harries on Feb 8, at the age of seventy-nine years, we lose one of the older generation of meteorologists Born on Jan 20, 1852, he entered the Marine Division of the Meteorological Office in 1875 In 1903 he was transferred to the Forecast Division, where he took regular duty as a forecaster In 1919 he returned to the Marine Division, where he held the post of assistant superintendent until his retirement in March 1920

Mr Harries' interest in meteorological matters extended beyond his official duties, however, especially along a number of curious bypaths of knowledge He was convinced that explosions in collieries were connected with high barometric

pressure and supported his thesis in a long letter to NATURE in 1887 (vol 36, p 437) He also developed the theory that some of the barometric depressions which visit the British Isles originate in tropical cyclones, and he actually succeeded in tracing the course of one such storm from the Philippines to Scandinavia, more than half way round the globe—no easy matter in 1882

The capacity for painstaking research which characterised this paper also marked Mr Harries' collection of occurrences of hail and thunder storms in Arctic regions, his study of the frequency, size, and distribution of hail at sea, and his paper on the great storm of November 1703, in which he brought to light some long-buried official records The same thoroughness, in a different direction, was shown in his paper on "The Eddy Winds of Gibraltar", in which he displayed great ingenuity in the use of simple methods of aerological investigation This paper was published in 1914 by the Royal Meteorological Society, of which he was a fellow from 1887 until 1914

DR FLORENCE BUCHANAN

BY the death of Dr Florence Buchanan on Mar 13, a familiar figure is removed from the laboratories at Oxford For the past ten years she had been handicapped by increasing blindness, but even so, occasional articles have appeared from her pen Previously she had carried out many interesting studies in the fields of zoology and physiology Her earliest papers, on the respiratory organs of decapods and on annelids, appeared in the *Quarterly Journal of Microscopical Science* while she was still a student at University College, London, and there the influence of Sir Ray Lankester turned her attention to zoological studies, particularly of the polychæts Later, with Sir John Burdon Sanderson at Oxford, she turned to physiological experiments upon the electrical response of muscle, recorded photographically by a capillary electrometer, and as a result of her investigations she was awarded several prizes, received the degree of D Sc from the University of London, and was made a fellow of University College

Throughout her physiological work, Dr Buchanan retained her first interest in animal life, and to a biologist some of her most striking researches were concerned with the frequency of the heart beat in small mammals and birds, with the varying rates of heart-beat in hibernating and waking mammals, and with the general problem of hibernation Heredity may have accounted for Dr Buchanan's scientific skill and enthusiasm, for she was a daughter of the late Sir George Buchanan, chief medical officer of the Local Government Board, and a sister of Sir George Seaton Buchanan and Lady Adam Smith, wife of the principal of the University of Aberdeen J R

THE death occurred on Sunday, Feb 15, of W G Robson, lecturer in natural philosophy in the United College of the University of St Andrews From 1892, when Mr Robson was appointed assistant to Prof A S Butler, he was almost continuously associated with the University either in St Andrews or Dundee During the War he was engaged in the Aircraft Instruments Department in London, and had charge of the Oxygen Research Laboratory His wide experience, kindly disposition, and his knowledge of mathematics, physics, and electrical engineering made him a most valuable member of the University staff

WE regret to announce the following deaths

Dr M W Beijerinck, founder and director of the Microbiological Institute at Delft, on Jan 1, aged seventy nine years

Prof G Gehlhoff, of the Technical Highschool, Berlin, president of the Deutsche Gesellschaft fur Technische Physik, vice president of the Deutsche Glastechnische Gesellschaft and a director of the Osram G m b H, who in recent years took a leading part in the development of glass technology in Germany and made a number of notable contributions from his own laboratory, died on Mar 12

Prof D Hepburn, C M G, professor of anatomy in the Cardiff Medical School of the University of Wales, formerly president of the Anatomical Society of Great Britain and Ireland, on Mar 10, aged seventy two years

Prof Carl Emil Hansen Ostenfeld, professor of botany and director of the botanical garden in the University of Copenhagen, on Jan 16, aged fifty-eight years

Prof Enrico Sereni, head of the department of physiology in the Stazione Zoologica, Naples, on Mar 1, aged thirty one years

Prof Otto Wallach, emeritus professor of chemistry in the University of Bonn, who specialised in the chemistry and industrial uses of the terpenes and was awarded the Nobel prize for chemistry in 1910, on Mar 1, aged eighty four years

News and Views

THE Council of the Royal Society has agreed to recommend for election as fellows of the Society the following seventeen candidates Percy George Hamnall Boswell, professor of geology in the Imperial College of Science and Technology, Alfred Joseph Clark, professor of pharmacology in the University of Edinburgh, Charles Davidson, assistant at the Royal Observatory, Greenwich, Reginald Ruggles Gates, professor of botany, King's College, London, Charles Stanley Gibson, professor of chemistry, Guy's Hospital Medical School, Hermann Glauert, Principal Scientific Officer, Royal Aircraft Establishment, Farnborough, Charles Robert Harington, reader in pathological chemistry in the University of London (University College Hospital Medical School), Isidor Morris Heilbron, professor of organic chemistry in the University of Liverpool, Sir Alexander Cruikshank Houston, Director of Water Examinations to the Metropolitan Water Board, Lieut -Col Sydney Price James, I M S, adviser on tropical diseases to the Ministry of Health, Charles Frewen Jenkin, lately professor of engineering science in the University of

Oxford, Stanley Wells Kemp, director of research, *Discovery* Expedition, Thomas Howell Laby, professor of natural philosophy, University of Melbourne, William Kingdon Spencer, palæontologist, Edward Charles Titchmarsh, professor of pure mathematics in the University of Liverpool, Wilfred Trotter, surgeon to University College Hospital, Miles Walker, professor of electrical engineering, University of Manchester

THE Dalton medal of the Manchester Literary and Philosophical Society, which was awarded to Sir J J Thomson on Mar 10 on the occasion of his visit to Manchester, was founded so far back as the year 1864, but, curiously enough, no allotment was made until 1898 The circumstances attending its early institution and production are somewhat obscure, at any rate it was a medallic gift to be adopted "for presentation on such occasions as the society may determine", a decision which left future bestowal an open matter, a point well seen in the awards, which have only occurred as follows Dr Schunck (1898), Sir Henry Roscoe (1900), Prof Osborne Reynolds (1903), Lord Rutherford (1919), Sir J J Thomson (1931) The medal is struck in bronze, the obverse bears the head of John Dalton, and on the reverse, within crossed laurel branches, is a sphinx, with accompanying legend, "Knowledge is Power" The first presentation of what was apparently an original Dalton medal was made on Mar 29, 1898, to Dr Edward Schunck, in "recognition of his series of researches on the natural colouring matters, with which he has enriched chemistry" Schunck had been a member of the Manchester Literary and Philosophical Society for fifty six years It may be recalled that on the occasion of the gift, Sir Joseph Hooker attended to receive the Wilde gold medal, whilst Sir Michael Foster delivered the Wilde lecture, with the title "On the Physical Basis of Psychical Events"

THE discontinuance of a medallic gift by a scientific society is unusual This has been the case, however, with the Wilde gold medal of the Manchester Literary and Philosophical Society In 1895, Dr Henry Wilde, a generous benefactor in many directions, established a fund, part of which was to be devoted to the annual award of a gold medal for distinguished services to science and philosophy The first medal was given in 1896 to Sir George Stokes for "pre eminent services to mathematical and physical science" Sir George visited Manchester in the following year, received the medal, and gave an address entitled "The Nature of the Röntgen Rays" The final gift of the kind was made in 1908 to Sir Joseph Larmor Referring to the article on the sesqui centenary of the foundation of the Manchester Literary and Philosophical Society in NATURE of Mar 14 (p 408), it has been pointed out by a correspondent that the Copley medal of the Royal Society was never awarded to John Dalton Dalton received the Royal Society's Royal medal in 1826, the first presented at the time of institution

THE election on Mar 9 of Prof Elie Cartan to the seat of the late Paul Appell in the Paris Academy of Sciences has added a prominent mathematician to the distinguished body of men of science of the Quai Conti Prof Cartan has specialised in the theory of groups and in higher geometry, and has developed these fundamental branches of mathematics in unexpected and far reaching directions We still remember the deep impression he made at the International Congress of Mathematicians in Bologna, when he showed how to determine a complete orthogonal system of functions in any Riemannian space with a positive curvature and symmetrical with reference to each of its points, and how to derive a geometrical representation of these series of fundamental functions by means of a special type of isometrical transformations Indeed in his numerous memoirs on these abstruse topics, Prof Cartan has given a remarkable generalisation to the Riemannian spaces, thus preparing the way to subsequent developments in natural philosophy

IN Newtonian mechanics, as is well known, gravitation has no influence on measurements as such In Einstein's universe, however, all measurements follow so closely the structural character of the gravitational field in which they are immersed, that a knowledge of the geometry of that field is equivalent to a knowledge of its physical properties, so that mechanics is implied in geometry again, as was the case during the golden period of Greek science It appears necessary, then, to labour in detail the manifold interpretation of the notion of space underlying the geometrical and physical description of the universe The curved space discovered by Riemann in 1853 which found its practical application in 1916, has to be itself generalised and enlarged if the future claims of theoretical physics have to be satisfied In this connexion "Cartan's spaces", by reason of their greater generality and completeness, are of supreme importance This was a new revelation to some of us who listened to his illuminating exposition at the International Congress of Philosophy at Naples in 1924, when Prof Cartan spoke of the torsional properties of space and the difficulties created by magnetic phenomena in the single vectorial representation of material particles The practical value of his intuitions has been confirmed since by the implications of De Broglie's wave mechanics, which seems to demand a more complex theory of groups for its geometrical interpretation As a mathematician, Prof Cartan has had a distinguished career Born in 1869, he studied at the École Normale Supérieure of Paris, and took his doctor's degree in 1894 He now occupies the chair of higher geometry, which was held previously by Darboux, at the University of Paris His numerous mathematical memoirs earned for him, last autumn, the Grand Prix of £400 of the Paris Academy of Sciences

AFTER a keen debate in the House of Commons, on Mar 16, Clause 4 of the Representation of the People Bill, which had been before the House in committee, was defeated by 246 votes to 242 The special claim of Queen's University, Belfast, was first brought forward by Mr Ross and supported by Col Sinclair, pro chancellor of Queen's University and its representative in Parliament This claim, however

was rejected by 178 votes to 168 The motion for the deletion of Clause 4 from the Bill was presented by Lord Hugh Cecil He analysed the question of equalitarian democracy, which is based on the 'one vote, one value' theory, and declared it does not and cannot exist He then appealed to the members not to spoil the tradition of true representation Major Church opposed his own party by strongly supporting this appeal He considers it intolerable that this bill should suggest that university education is not of special value, especially in view of the fact that the universities are no longer class preserves and produce advisers to governments and leaders of science and industry Mr Clynes refused the appeal for a free vote, pointing out that, at least, there is no justification for giving university voters twice the representation of other voters He pointed out that university members have shown little special political capacity The Government was also supported by Sir Herbert Samuel

IN a pamphlet entitled "A National Policy" (London Macmillan and Co, Ltd 6d), describing the programme advanced by Sir Oswald Mosley, M P, there are some references to scientific research which, without trenching on questions of party politics, it may be of interest to summarise No task, it is argued, is of more vital importance than that of mobilising our great scientific resources and attainments Great Britain's industrial future depends on the rapid and effective adoption of new scientific results more than upon any other single factor Our high degree of industrialisation, our unrivalled technical experience, the skill of our workers, our great resources of scientific ability and devotion, give us the opportunity to maintain our lead indefinitely What is chiefly lacking is the effective co ordination and application of our resources The work of the Department of Scientific and Industrial Research is commended, but it is said that the scale on which it is allowed to operate is too limited A method must be adopted by which new devices and inventions can be carried through the difficult intermediate stage between successful laboratory results and commercial exploitation At present, the Department can only test inventions at the owner's expense and issue a report on the results A certain maximum sum should be set aside each year for the Department's use for the development of a small number of selected inventions which after making a suitable financial arrangement with the patentee, should be taken right out of the laboratory stage and put on the market under public auspices

SIR OSWALD MOSLEY also suggests the fostering of inventions and the extension of agricultural and medical research, while an organised attempt might be made to standardise many of the basic products of industry for mass production purposes, comparable to Mr Hoover's remarkable campaign in the United States of America The establishment of new industries under the direction of a National Investment Board is advocated where these industries might be of great value to the community though as yet they are not in a position to attract private enterprise Thus, coal carbonisation appears to be insufficiently profitable to attract an adequate amount of private capital, but its establishment, it is suggested, might be justified on grounds of public policy, because (1) it might mean the 'salvaging' of a large amount of the community's capital which has been sunk in coal mining and would be rendered profitable again if a new market for coal were created, (2) it would lessen our dependence on imported oil fuel, (3) a smokeless fuel would be produced, and (4) the new work available in the coal fields would mean a saving in unemployment relief

THE Council of the Linnean Society of London has reached an important decision with regard to the publication of the *Proceedings* of the Society The *Proceedings*, instead of being published in an annual volume, are being issued sheet by sheet of 16 pages, and in this way an abstract of a paper read before the Society may be in the hands of fellows and of the public between three and eight weeks after the reading of the paper Each sheet of the *Proceedings* so issued will rank as a publication on the date of issue, so that the utmost is being done to conserve for contributors to the Society the priority of their discoveries, provided, of course, that in the case of new species a sufficient diagnosis accompanies the publication of the new name This precaution has not been taken, for example, in the case of a new species of *Hoplophorus* described in a recent issue, so that the advantage of early publication is lost in this case The importance in time of the arrangement which has now come into force is well illustrated by the first sheet of the new issue The *Proceedings* of Nov 20, 1930, were issued on Dec 17, whereas the annual volume issued in January 1931 contains reports of 'proceedings' so far back as Nov 7, 1929 Arrangements have been made whereby fellows, foreign members, and associates who still wish to possess the complete *Proceedings* in book form may obtain a copy each year at half the published price

THE Belfast Naturalists' Field Club, for some time past, has had under consideration the advisability of making a survey of the antiquities of that part of Northern Ireland covered by it and its affiliated societies Both the number and character of these antiquities and the risks to which the better known are exposed in modern conditions have been judged to make the matter one of such importance that the authorities of the Field Club have appointed a special committee to deal with it Members and others have been asked to co operate with the Committee by sending in lists, with full particulars, of any antiquities in their neighbourhood, especially those which are not included in the Ordnance maps Plans, sketches, and photographs are to be included, with a statement of exact position The topographical and full bibliographical details will be indexed and made available for consultation by students The scheme will cover buildings, monuments, and other remains of both historic and prehistoric times The chairman of the Committee is Mr H Albert Campbell, and the honorary secretary, Miss M Gaffikin

THE course of popular lectures on the native races of the British Empire given under the auspices of the Royal Anthropological Institute came to an end for the current session on Mar 11 with Mr E Torday's lecture on "The Things that Matter to the African" Mr Torday's lecture was a subtle but most illuminating interpretation of native life and tradition in West Africa, in which he showed that the frivolous, light hearted individual of many travellers is far from being the real man In fact, he appears to be something of an opportunist, for, while bowing to the domination of the sultanates, he has, at heart and in actual practice, remained a thorough democrat, in accordance with his long established tradition The case was well argued and convincingly supported by a wealth of detailed evidence which covered both religious belief and social custom Full justice was done to the remarkable but too little known character and influence of the women Mr Torday's conclusion that the West African is capable of concerted and persevering action when he aims at social ideals, taken with what he said in the body of his lecture, is both a warning and a guide to our administrators For it would appear that under the impact of European influences, a new culture is shaping which will differ from that of the past, but in which our share will depend very much upon our sympathetic understanding of native tradition We trust that Mr Torday's lecture will be given permanent form, for it is, without question, one of the most important pronouncements on the West Africans which has been made in recent years

INTERNATIONAL telephony has made wonderful progress during the past year At the beginning of 1929 radio telephony provided daily telephone service to more than twenty-six countries In 1930 the total of international connexions wholly or partly effected through radio telephony was increased to 177 The most important groups of connexions can be divided into three classes, the first one linking North and South America This group connects the United States, Canada, Cuba, and Mexico on one side with the Argentine, Chile, and Uruguay on the other The second group involves three new channels between Europe and South America They operate from Paris, Berlin, and London to Buenos Aires Land line connexions bring a total of twenty other countries into these circuits The third group involves the London Sydney circuit—a distance of 9192 miles These circuits connect most of the telephone users of the United States, Canada, Mexico, Great Britain, Hungary, and Italy with Australia Many more lines are being constructed, including one connecting the United States and Australia directly Spectacular conversations have been held from an aeroplane over the city of Buenos Aires with points in the United States, with the s s *Majestic* on the high seas, and with Sydney, Australia, a distance of 14,000 miles A conversation has also been transmitted round the world from Schenectady and then broadcast According to *Electrical Communication* for January, the international telephone directory (A T 1) for 1929 contained about 12,000 entries from 1485 towns in 27 different countries, the 1930 edition contains more than 50,000 entries from 2718 towns in 38 countries

THE tenth annual report of the Electricity Commissioners, which has just been published, shows clearly that the electric supply industry in Great Britain has been little if at all affected by the almost universal trade depression Dividing the country into regional districts of supply, linking up all the efficient large power stations, and gradually eliminating where possible the less efficient stations, is leading to a better utilisation of our coal resources The total number of units generated in the year ending in March 1921 was 5167 million units and the fuel consumption was 7 356 million tons For the year which ended in March 1930, the total number of units generated was 11,961 million, with a fuel consumption of 10 141 million tons It will be seen that although the number of units generated has been doubled, the consumption of coal has only increased by about 50 per cent Last year was noteworthy because of the continued expansion of the supply and the many schemes that are being put in hand for the improvement and further extension of public supplies The steady growth of the domestic supply has had a stabilising effect on the industry The units generated last year show an increase of 10 per cent of the number generated in the preceding year A number of small stations have been erected in isolated districts On the estimated population of Great Britain (44 5 millions) the sales of electrical units represent 193 units per capita, as compared with 171 in the previous report The question of rural development is discussed and it is pointed out that the prospects are favourable in certain cases

THE prize for 1930 for an improvement in the science or practice of navigation offered by the Royal Society of Arts, under the terms of the Thomas Gray Memorial Trust, has been awarded to Messrs Charles A Stevenson and David Alan Stevenson, of Edinburgh, for their invention of the talking beacon installed at Cumbrae Lighthouse The beacon, to which reference was made in NATURE of Jan 24, p 138, consists of an ingenious combination of fog signal and wireless transmitter The fog signal consists of three blasts followed by a short silence and then two further blasts At the same time, on a wireless receiver, a listener hears (*a*) the name of the beacon in speech (Cumbrae), (*b*) the three blasts of the fog signal, (*c*) counting in speech, in cables and sea miles up to five miles, and (*d*) the two blasts of the fog signal This is followed by a silent interval lasting twenty-seven seconds and is then repeated Immediately before each mile is spoken a bell is sounded The distance which the observer hears in his receiver, coinciding with the end of the third blast heard through the air, gives him the distance of his ship from the lighthouse The spoken words in the signal come from a gramophone record on a turn table, which is engaged and disengaged by means of a clutch with another turn-table kept constantly revolving by air turbine or motor The Council of the Royal Society of Arts is offering this year another prize of £100 to any

person who may bring to its notice a valuable improvement in the science or practice of navigation proposed or invented by himself in the years 1930 and 1931, and a prize of £100 for an essay on "The Stability of Ships, with special reference to the particulars which should be supplied by Shipbuilders, and also the value of any mechanical devices for ascertaining the M G, with which you are acquainted" Claims and essays must reach the Secretary, Royal Society of Arts, John Street, Adelphi, London, W C 2, not later than Dec 31, 1931

AT a conference at the Birmingham section of the British Industries Fair, Dr C H Lander, Director of Fuel Research, discussed the "Gas Industry in relation to British Fuel Problems" He stressed the importance of its contribution to the smoke problem, as a purveyor of smokeless fuels, to the domestic heating problem, and to the problem of obtaining oil and petrol from coal The carbonisation industries produce solid, liquid, and gaseous fuels and so all their problems are related and need to be considered together The current abundance of liquid fuels should not blind us to the possible future need for deriving supplies from coal The gas industry is well placed for marketing all the products of the carbonisation and hydrogenation of coal or its products In view of the potential contribution of the carbonisation industries to the reduction of smoke Dr Lander pleaded for collaboration of the gas and coking industries in the utilisation and marketing of their products Sir Arthur Duckham contrasted the potential contribution of the gas industry to the fuel problems of Great Britain with the legislative shackles imposed on its development, the restrictions placed on the use of gas by some local authorities, arising from an imperfect grasp of fuel problems by the general public and even by our legislators

THE first number of vol 3 of the *Collection of Czechoslovak Chemical Communications* (Jan Feb 1931) is a special issue dedicated to the memory of Prof František Wald, who died suddenly in October of last year His chief contributions to the advancement of science in central Europe were outlined in the obituary notice which appeared in NATURE for Jan 10, p 64 Had he lived Prof Wald would have attained seventy years of age last January, and the original intention of the editors of *Collection* was that this issue should have been a jubilee number in his honour Right up to the time of his death, Wald was engaged in elaborating his phenomenalistic theory of phases and stoichiometry These views are embodied partly in an article by his friend Dr A Kříž, and partly in a hitherto unpublished article by Wald himself, entitled "Foundations of a Theory of Chemical Operations" From these, it is clear that he disregarded much of the atomic theory and his definitions of elements and compounds do not coincide with those accepted generally His ideas attracted the attention of Prof Wilhelm Ostwald, whose friendship he enjoyed and who included him among the "Great Men of Science" Prof Wald was for many years chief chemist to an important metallurgical undertaking at Kladno, and among his seventy contributions to various scientific periodicals are several dealing with the adaptation of standard methods of chemical analysis to the special needs of metallurgy, especially to the evaluation of ores and the analysis of alloys In addition to appreciative articles on Wald's life and work, this special number of the Czechoslovak *Collection* contains several other articles of outstanding merit, including an account of some iron carbon silicon alloys (by Drs Kříž and Poboříl) and further polarographic studies with the dropping mercury cathode by Prof Heyrovský and collaborators, who find that in acid solution, nitric oxide is reduced to ammonia at a potential of 0 77 volt from that of the normal calomel electrode

WE have received a copy of the Subject Index to volumes 1 to 60 of the *Journal of Physiology*, which has been prepared by Dr J G Priestley, of Oxford The Physiological Society recently published a history of its first fifty years, written by Sir Edward Sharpey Schafer, and an author index to the first sixty volumes has also been issued These three volumes cover an important period in the history of physiology, a period which has seen its development into the science of to day *An important part of this development is* represented by the papers appearing in the first sixty volumes of the *Journal* The index has been made as complete as possible thus, where a subject can be considered from more than one point of view, entries referring to each of them are given In addition, the species on which the observations were made is also noted It runs to upwards of two hundred pages, and is published by the Cambridge University Press as a supplement to the first number of volume 71 of the *Journal of Physiology*, issued in January

THE Ministry of Agriculture desires to notify poultry farmers that it is now issuing a fowl pox vaccine at a charge of one penny per dose, with a minimum charge of 2*s* 6*d* covering a supply of 30 doses, with an instrument and brush for application The vaccine has been extensively tested, it is free from danger, and causes no constitutional disturbance It confers definite immunity of at least four months' duration Cash must be enclosed with each order, which should be addressed to the Director, Ministry of Agriculture and Fisheries Veterinary Laboratory, New Haw, Weybridge, Surrey The Ministry has also issued a bulletin (No 26) on Johne's disease, which gives a full account of this important disease of cattle The bulletin, price 3*d* post free, may be obtained from the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S W 1

At the annual general meeting of the Society of Public Analysts held on Mar 4, the following officers for the year 1931 were elected *President*, Dr J T Dunn, *Hon Treasurer*, Mr E B Hughes, *Hon Secretary*, Mr F W F Arnaud

AMONG recent appointments made by the Secretary of State for the Colonies to the Colonial Agricultural Service are the following Mr H R Surridge, as agricultural officer, Fiji, and Mr H E Box, as entomologist, Antigua, Leeward Islands

SIR ARTHUR SMITH WOODWARD will deliver the Huxley Memorial Lecture at the Imperial College of

Science and Technology, South Kensington, on Monday, May 4, at 4 P M His subject will be "Modern Progress in Vertebrate Palæontology"

AT the annual meeting of the Geological Society of London held on Feb 21, the following officers were elected *President* Prof E J Garwood, *Vice Presidents* Mr J F N Green, Prof J W Gregory, Dr H H Thomas, and Prof W W Watts, *Secretaries* Mr W Campbell Smith and Prof W T Gordon, *Foreign Secretary* Sir Arthur Smith Woodward, *Treasurer* Mr F N Ashcroft

THE Masters' Memorial Lectures of the Royal Horticultural Society will be delivered in the lecture room of the Society's new hall in Greycoat Street, Westminster, on Wednesday and Thursday, April 8 and 9, at 3 30 P M, by Prof Erwin Baur, on "New Scopes and New Methods of Plant Breeding" and "The Problem of Evolution" Sir Daniel Hall and Sir Frederick Keeble will take the chair on these occasions

IT is announced by Northern News Services, Ltd, that Dr Hjalmar Broch director of the marine biology station of the University of Oslo, has been appointed by the Jugoslav Government to be director of the Institute of Deep sea Research and Fishery Investigations in the Adriatic The Jugoslav institute is being built at Split (Spalato), where all branches of science concerning deep sea research will be represented, including zoology, botany, and oceanography Local methods of fishing will also be investigated, with the view of modernising and rationalising these

A NEW article of association of the Royal Zoological Society of New South Wales, giving the council power to confer the title 'fellow' on any member or associate member of the Society who has rendered distinguished service to Australian zoology, has recently been formulated The council has conferred this title upon Dr R J Tillyard, H J Carter, W W Froggatt, T Iredale, A F Basset Hull, and T C Roughley, all of whom have contributed largely to scientific journals articles dealing with the various branches of Australian zoology The title is purely an honorary distinction

ACCORDING to the records obtained at Kew Observatory, the epicentre of the destructive earthquake which occurred in the Balkans at 1 h 50 m G M T on Mar 8 was near 41° N, 21° E The disturbance was about four times as violent as the shock which occurred in the same region at 0 h 16 m G M T on Mar 7 According to a revised estimate, the position of the epicentre of this earlier shock is 42° N, 23° E The earthquake which was felt in Japan on Mar 9 was recorded as a large disturbance at Kew Observatory A United States Coast and Geodetic Survey broadcast message gives the epicentre as 43° N, 140° E

ON Mar 13, Sir Frederick Gowland Hopkins, president of the Royal Society, unveiled, in one of the principal laboratories of the London School of Hygiene and Tropical Medicine, a memorial plaque in memory of the late Lord Wandsworth, who left a sum of £10,000 to found a scholarship for the promotion of medical research in one of the London medical schools The ceremony was performed in the presence of Sir William Hamer and Dr E Deller, Principal of the University, and others, during an official inspection of the School by the University of London In unveiling the tablet, Sir Gowland Hopkins expressed the hope that the work already done and the opportunities for the future which the scholarship afforded would be an abiding source of inspiration

THE Association of British Chemical Manufacturers has issued an "Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry" Copies of this publication (price 2s net) may be obtained from W Heffer and Sons, 4 Petty Cury, Cambridge

SOME years ago, Dr Marie Stopes suggested that coital interlocking between the glans penis and the cervical canal occasionally occurred in man The phenomenon was, on anatomical grounds, scarcely credited (see NATURE, Oct 25, 1924, p 601, and Nov 15, 1924, 719) Dr Stopes now states (*C B C Bull*, No 2 1930) that the occurrence has been confirmed in 48 cases attending the Clinic for Constructive Birth Control and in others, 59 cases in all

THE Kodak Research Laboratories have just issued the thirteenth volume of abridgments of their scientific communications published in 1929 There are 37 of them in the volume, by 32 authors The subjects include physical photographic, and physiological optics, organic, physical, and colloid chemistry, photographic theory, and practical photography The abridgments are very full, giving all the essential details of the original papers

THE winter, 1930–31, issue of *The Fight against Disease*, the quarterly journal of the Research Defence Society, contains an article by Dr J H Burn on the use of animals for the standardisation of remedies, in which he points out that animal tests of activity are necessary not only for antitoxins and insulin but also for the arsenobenzenes An account is given of the debate in the House of Commons upon Commander Kenworthy's Bill to prevent the application of public money to vivisection experiments, which suffered the unusual fate of being refused a first reading

As a result of long standing trials, the National Institute of Agricultural Botany at Cambridge is well qualified to give reliable advice to farmers, and, as is pointed out by the Institute, the selection of the right variety of a crop may make all the difference between success and failure The publication of *Farmer's Leaflets* Nos 2, 3, 4, and 5, dealing respectively with cereals for spring sowing, potatoes, lucerne, and sugar-beet, should, therefore, prove of immediate benefit to the farming community The leaflets may be obtained post free on application to the Institute at Cambridge

UNDER the title of "Canada 1931", the Dominion Bureau of Statistics has published a handbook of the present conditions in Canada (Ottawa Dominion

Bureau of Statistics London High Commissioner for Canada) The small volume supplements the larger and more purely statistical "Canada Year Book" and gives enough comparative statistics to present a survey of most aspects of Canadian activity The reviews of agriculture, mining, and the development of water power are useful summaries A statistical appendix gives tabulated figures for the last ten decades in population, production, trade, and other matters There is also a list of official sources of information relating to Canada

Applications are invited for the following appointments, on or before the dates mentioned —A male fishery officer in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (Mar 31) A biochemical assistant at the Hannah Dairy Research Institute, Auchincruive, Ayr—The Secretary, Hannah Dairy Research Institute, Auchincruive, Ayr (April 1) A junior technical examiner in the Lands Branch of the War Department —The Secretary, Civil Service Commission, Burlington Gardens, W 1 (April 16) A head of the science and engineering department of Highgate School—The Headmaster, School House, Highgate (May 10) An adviser in entomology for the Bristol Province under the Advisory Scheme of the Ministry of Agriculture and Fisheries—The Acting Registrar, The University, Bristol

Our Astronomical Column

The Corona without an Eclipse —M B Lyot's experiments with a sensitive polarimeter from the summit of the Pic du Midi, which is 9439 feet high, undoubtedly indicate the most hopeful means of observing the corona without an eclipse They are fully described in a bulletin dated Feb 14 issued by Science Service, Washington, D C A screen was used to cover the image of the sun's disc, and the prominences were then visible without the aid of a spectroscope The polarised light that he ascribes to the corona can only be traced for 3′ or 4′ above the sun's limb, so that the method only extends to the bright inner zone of the corona It is only observed in one position angle at a time, but by rotating the instrument round the sun's limb, it can be studied in all position angles Dr Deslandres is hopeful that it may be possible to photograph the images thus obtained The article recalls that François de Plantade, an assistant of Cassini, used the Pic du Midi for astronomical observations two centuries ago It also refers to the attempts of Prof Hale and Dr Steavenson to photograph the corona from high mountains, they did not, however, employ a polarimeter A complete check of the new method will be afforded when the moon is very near the sun, but not actually encroaching on the disc, if the method is sound, the dark disc of the moon should be discernible

The System of ξ Ursæ Majoris —This has long been known as an interesting double star with a period of 59 8 years, it has been followed through more than a revolution In 1905, Norlund detected an oscillation in the bright star with a period of 22 months, indicating that it has a close companion The fainter star was found to be a spectroscopic binary, with a period of 9 8 days, by the Lick observers in 1918 *Lowell Observatory Bulletin* 432 contains a discussion of the spectroscopic orbit by L Berman The discussion is complicated by the double orbital motion, the light time changes considerably during the description of the large orbit The 22 month orbit is turned nearly edgewise to us, and observers are asked to watch for a possible eclipse on Feb 4 or 5, 1932 We see the 9 8 day orbit nearly fully open, so the radial motion in it is small A very accurate parallax can be derived from a combination of the data, the adopted value is 0 126″, giving a distance of 26 light-years The combined mass of the brighter pair is 1¼ sun, that of the fainter pair is equal to the sun Both the visible components are about 1¼ times as dense as the sun The semi major axis of the 9 8 day orbit is 7,319,500 km, that of the 59 8 year orbit is about 20 astronomical units The spectrograms were measured by Mr Berman and Miss Hobe, they determined their personal equations by measuring spectrograms of Venus, the radial velocity of which is accurately known

Annuaire Astronomique Camille Flammarion, 1931 —This useful almanac (Observatoire de Juvisy, 12 francs) contains details of the positions of sun, moon, and planets, diagrams of the orientation of the solar equator in different months, data of all oppositions of Mars up to 1956, elements of Pluto with a diagram of its orbit and details of the two total lunar eclipses of 1931, which are both visible in England and France There is an excellent table of the elements of the orbits of periodic comets, compiled by M Baldet it includes comet Schwassmann Wachmann III (1930 *d*) There are also meteorological data and many useful tables of physical constants One notes the interesting fact that Mt Canigou can be seen from Marseilles projected upon the setting sun on certain days in February and October, the distance is 253 km, and the straight line joining the points is 120 m below the sea at the middle point, the visibility depends on refraction

A table of Easter up to 2319 may interest some readers One notes that Easter occurs in March once in 4½ years, it will not occur on Mar 22 (its earliest date) until 2285 It is, of course, assumed that the present mode of reckoning will be continued

Report of the Leyden Observatory for 1930 —The Report begins with acknowledgment of the gift of 110,000 dollars from the Rockefeller Foundation It is being used for the construction of a photographic equatorial of 40 cm aperture, which will be erected at Johannesburg, thus strengthening the connexion between Leyden and the Union Observatory Dr van den Bos has now become chief assistant at the Union Observatory Prof Hertzsprung and Mr van Gent are there temporarily

The meridian circle at Leyden was used for observation of the Eros reference stars The proper motions of the reference stars in the selected areas are being discussed, also those of stars in the Pleiades in connexion with Prof Hertzsprung's investigation Mr Kuiper has observed double stars with the 10-inch refractor on 63 nights

Mr van Gent has photographed several southern fields with the Franklin Adams camera, and has detected 82 known and 28 new minor planets Prof de Sitter and Dr Oort have investigated the radial velocities of the spiral nebulæ in relation to the theory of relativity and the rotation of the galaxy

Research Items.

The Society Islanders.—A study of the physical characters of the Society Islanders by H. L. Shapiro, and based upon material collected in the field on the Bayard Dominick Expedition by S. Craighill Handy and Willowdean C. Handy, is published in vol. 11, No. 4, of the *Memoirs of the Bernice P. Bishop Museum*, Honolulu. Eighteen characters were examined and fifteen indices calculated on two hundred and two individuals. The measurements of 153 only are included here, as 49 were excluded on the ground of non-Polynesian admixture. From a study of the distribution of these characters, which show bi-modal and multi-modal curves common to both sexes, it is concluded that there is heterogeneity in the population. The impression of massiveness and size is borne out by the measurements. The stature of 171.35 cm. places them among the tallest people in the world. The head is of medium length and of more than medium width, giving an index markedly brachycephalic. Both face height and width are large, producing a massive face. The forehead, however, is narrow, giving the distinctive character associated with the Polynesian. The nasal index is mesorhine; but the average dimensions are considerable, though they do not equal the average of the Samoans and Tongans. In bodily proportions and size the Society Islanders are relatively large. In general, the women display the same development as the men. Most of the Islanders have black hair. There are no blondes; but 13.14 per cent of the men and 15.15 per cent of the women have reddy-brown hair.

Tribes of the White Nile Province.—Some notes digested from reports and essays of members of the administrative staff by Mr. J. A. Reid are given in *Sudan Notes and Records*, vol. 13, pt. 2. The information has been collected since 1924. For practical purposes the province is divided into three areas: (1) the Kawahla group, (2) the Baggara group, and (3) the rest. The Kawahla group, the Hassania, Huseinat, and Kawahla proper, occupy the Geteina district and the riverain part of Dueim and Kawa, the first two being the predominant partners. They are now a river-dwelling, semi-nomadic folk, spending most of their time near the Nile, except when they go inland to cultivate their rainland and seek green pasture for their animals. As soon as the rains are over, they start cultivating the river flats and bring their animals to the water, where they remain until the next rains. They acquired their present *dâr* by conquest. Though the land must have been held in tribal holding originally, individual ownership developed rapidly. Blood money, originally paid in camels, as they owned no cattle, is now paid in cattle or ready money. The Baggara group extend from the southern end of the province, just south of Kawa, to the Upper Nile boundary. They are, in a general sense, the semi-nomadic Arabs whose business in life is cattle breeding and who ride on bulls, while they leave to slaves and others the cultivation of the ground. Even with extensive sheep owners, the flocks are of comparatively recent origin and are soon exchanged for wealth in cattle. During the rains, the Baggara move from the river and wells, the extent of their migrations being governed by the fly. Practically all cultivate, but it is not their main object. Land, to begin with, belonged to the tribes, being held by the chief as trustee; but there were very definite rights of usufruct. When, on the lighter lands, a man had cleared a piece of land, it would be only in very exceptional circumstances that he would be disturbed, and on his death it would pass to his heirs eventually. The rights of ownership are more marked on the heavier cotton-growing lands. "The rest" are tribes living on the eastern and western flanks of the centre of the province, of no great importance, and in some cases merely survivals which cling to their tribal identity.

Observations on Indian Annelida.—In the *Proceedings* of the Seventeenth Indian Science Congress, held at Allahabad (Calcutta: Asiatic Society of Bengal), abstracts of fifty-three zoological communications are given. The majority of the papers were on parasites, insects, fishes, and cytology. It is interesting to note that several post-larval *Polygordius*, probably allied to *P. lacteus*, were taken in the tow-net near Madras, and with them, early larvæ. The latter were kept under observation for a few days and proved to have an 'amnion', as in *P. lacteus*. Another paper dealt with the alimentary glands in a surface-feeding earthworm, *Eutyphœus*. These glands, formerly mistaken for calciferous glands, are not situated on the œsophagus but much farther back—a little behind the middle of the body. They occur in connexion with the typhlosole, open into the gut by several apertures, and have a special blood supply. Preliminary experiments appear to indicate that they have a digestive (peptic) function.

Ascidians of Porto Rico and the Virgin Islands.—In connexion with the "Scientific Survey of Porto Rico and the Virgin Islands", Dr. Willard G. Van Name has, in vol. 10, part 4 (New York Academy of Sciences; 2 dollars), described the Ascidian fauna of the region. A very clear account of the 35 species collected from the coasts of these islands is given, with the diagnostic characters of the families and genera concerned. Numerous plates and sketches are used in illustration. The ascidians of Porto Rico and the Virgin Islands are, as might be expected, typical tropical and subtropical forms, some of which are restricted to the region including the West Indies, Gulf of Mexico, Caribbean, and Bermuda, whilst others, such as *Trididemnum savignii* and *Styela partita*, are found in practically all the warmer seas of the globe. A close relationship exists between the ascidian fauna of the West and East Indies, 18 of the West Indian species being represented in the East Indian region. One West Indian species, *Perophora viridis* (Verrill), is considered identical with *P. listeri* (Forbes and Hanley) of European waters. Two species only, *Ascidiella styeloides* and *Microcosmus anchyloderus*, are restricted to Porto Rico and the Virgin Islands. It is interesting to note that the ascidians of these islands, with one exception—*Pyura antillarum* (from 496 fathoms), are littoral forms. A considerable amount of dredging has yielded no truly deep-sea forms. Hartmeyer's revised classification of the Tunicata (1915) is used throughout, except that Lahille's orders—Aplousobranchiata, Phlebobranchiata, and Stolidobranchiata—are substituted for the Krikobranchia, Dictyobranchia, and Ptychobranchia of Seeliger. In addition, the distinct genus *Perophora* of Hartmeyer is included under the Ascidiidæ. The Botryllidæ are regarded as a distinct family of the order Stolidobranchiata. Linde (1923) and Michaelsen (1928) include them as a subfamily of the family Styelidæ, to the compound forms of which they are, without doubt, closely related.

Digestion of Cellulose by Insects.—Although a very large group of insects feed on woody tissues of plants and even on dry wood consisting almost entirely of cellulose, practically nothing is known as to whether these insects are able to digest cellulose. The problem

has been investigated successfully only with regard to wood eating termites, in which the digestion of cellulose was found by Cleveland to depend on the presence, in their intestinal tract, of symbiotic Protozoa (Flagellates) Many other wood-feeding insects were investigated by Buchner and his pupils from a purely anatomical point of view, and in the majority of them various symbiotic micro organisms, often harboured in special organs (for example, the so called 'fermentation chambers'), were discovered This anatomical evidence was considered sufficient to postulate a theory that the micro organisms must assist their hosts in the digestion of cellulose, and this theory is commonly accepted However, recent investigations by W Ripper (*Zeit vergl Physiologie*, 13 Bd, 2 Heft, 1930), who used biochemical methods, throw considerable doubts on the assumed rôle of symbiotic micro organisms in wood eating insects This author has proved the presence of a cellulase (cellulose digesting enzyme) in the intestinal juice of several insects not possessing symbionts, which result suggests that the digestion of cellulose can occur without the assistance of symbionts On the other hand, no cellulase was found in the 'fermentation chambers' of other wood boring larvæ, although these organs are required by Buchner's theory to harbour cellulose digesting micro organisms Again, in the case of certain unspecialised wood borers, the percentage of cellulose in the wood consumed and in the excreta proved to be the same Thus some wood borers do not utilise any of the cellulose of their food, others can digest it without symbionts, while the organs harbouring symbionts may bear no relation to the digestion of cellulose It appears that further research on biochemical and physiological lines is necessary for the elucidation of this highly interesting and complicated problem

The Tetraploid Chinese Primrose—*Primula sinensis* has been a subject of genetic investigation for many years A recent paper by Mrs Sverdrup Sömme (*Jour Genetics*, vol 23, No 3), who formerly worked at the Merton Laboratory, is concerned with the genetics and cytology of the tetraploid form This has arisen at various times in different strains and the view is favoured that it results from a suspended mitosis in the fertilised egg It is a stouter plant, a cell giant, with 48 chromosomes, and is less fertile than the diploid In the first studies of this tetraploid, Gregory found certain factors duplicated and he assumed that in meiosis the chromosomes would mate in pairs derived from either parent Mrs Sömme, however, finds that the genetic behaviour is that which would be expected if random pairing takes place between any two of the four homologous chromosomes in each set The two hypotheses are tested as regards the factor (S) for heterostylism, Gg for green or red stigma, and other pairs of factors Plants of constitution S_2s_2 gave an F_2 ratio of 35 1, and a ratio of 5 1 in back crosses, strongly supporting the theory of random conjugation between the four chromosomes Only two of the genes studied show complete dominance when present in a single dose Three of the genes show linkages in the tetraploids, which correspond to the linkages in the diploid But crossing over can take place between any two of the four homologous chromosomes In diakinesis, some of the sets of four are seen to be arranged as quadrivalent chromosomes, but usually only one or two are present in each pollen mother cell In all the attempts to cross $2n$ and $4n$ plants, only three triploid (sterile) plants were obtained This extensive and accurate record of genetic experiment is concluded with a discussion of tetraploidy as a factor in evolution, in which the author justly argues that the multiple factors in wheat and other plants have probably arisen through polyploidy

Cambrian Arthropods—Two of the many remarkable fossils discovered by Walcott in the Middle Cambrian of British Columbia have been re-studied by G E Hutchinson (*Proc U S Nat Mus*, **78, art 11**, pp 1 24, pl 1, 1930) One of these, a crustacean named *Opabinia*, was placed by Walcott in the Anostraca, and this view of its position has been confirmed by later writers The most conspicuous feature of the head is a large cylindrical process in front which, in living forms, is developed from the fused internal or frontal appendages of the antennæ in the male In structure *Opabinia* agrees with living Anostraca in many respects, but differs in the smaller number of trunk segments, the larger number of appendage bearing segments, the presence of only one or two post pedigerous segments, and the absence of branchiæ and a caudal fork On account of these differences it is considered that *Opabinia* should be placed in a separate sub order of the Anostraca The presence of this genus in a marine deposit is of interest since the living Anostraca have a fresh-water habitat *Rochdalia*, from the Middle Coal Measures of Lancashire, is thought to be allied to *Opabinia*, and was apparently of fresh water habit The other genus studied by Hutchinson, *Aysheaia*, was regarded by Walcott as a polychæt annelid, but later authors have been impressed by its resemblance to the living Onychophora (*Peripatus*, etc), and further study confirms this view of its relationship Some differences in structure, however, support the opinion put forward by Hutchinson that the Onychophora should be divided into orders 1, Protonychophora, to include *Aysheaia*, 2, Euonychophora, to include the living forms The Cambrian genus is of interest as being marine, whereas the living representatives are terrestrial C E Resser (*Proc U S Nat Mus*, **76**, art 9, pp 1 18, pls 1 7, 1929) describes and figures some beautifully preserved specimens of phyllocarid crustacea from the Lower and Middle Cambrian of British Columbia, Pennsylvania, and Manchuria

Middle Ordovician in Central Norway—In Ottadal, central Norway, a remarkable rock known as 'serpentine conglomerate', and hitherto regarded as a picrite lava or a tuff agglomerate, has been found by P A Øyen and Iver Haugen to yield a rich though obscure fauna Some three thousand specimens have been placed in the hands of the Swedish State-geologist, Herman Hedström, who has just published a preliminary report (*Avhandl Norske Vidensk Akad*, 1930, No 10, 10 pp, 2 pls) The shells have been changed into iron carbonate and details are often lost, but enough remains to identify the fauna as corresponding with the *Orthoceras* Limestone and *Asaphus expansus* beds of Sweden—the 3 c γ and β of Norway Gastropods abound, trilobites and cephalopods are fairly common, and there are also brachiopods and lamellibranchs Hedström regards the rock as a true conglomerate, contemporaneous with the fauna and formed from older peridotites In any case, this discovery will have to be reckoned with, in interpreting the geology of central Norway

Datum Planes for Charts—The problem of satisfactory datum planes for maps, and particularly hydrographic charts, is fully discussed by Mr H A Marmer in "Chart Datums" (U S Coast and Geodetic Survey, Special Publication 170) The arbitrary datum level is clearly of little value for charts, since it gives no absolute information regarding depths Moreover, it is clear that the datum plane should be one that is capable of recovery even if all bench marks are lost Tidal datum planes alone are satis-

factory A high-water datum may be very useful for certain purposes such as the clearance of bridges or warehouse construction along the water front, but it is unsatisfactory for nautical charts, inasmuch as it gives a false idea of security Mean sea level datums are fairly satisfactory but may cause trouble or danger in shoal areas The needs of the sailor are best served by low water datum planes, but the de termination of these is not an easy matter, owing to periodic variations in the tide Mr Mariner discusses the nature and extent of these variations A mean low water datum is relatively easily determinable on any coast and may be fairly satisfactory It is used on the charts covering the Atlantic coasts of the United States A datum of lower low water is reached from half as many observations as that of mean low water This is most suitable for coasts on which the tide is of the daily and not of the semi daily type It is used on the Pacific coast charts of the United States Another datum that can be used is that of spring low water This, of course, requires a long time for determination, and tends, in use, to give an appearance of unnavigability to many waters, and also to indicate rocks and reefs which are rarely visible to the mariner

Recent Researches on Relativity —Lemaitre and Sir Arthur Eddington have shown that our actual universe may probably be considered as expanding from an initial state something like Einstein's world filled with matter, towards a limiting state like de Sitter's world ', which is empty or rather has all the matter swept into unobserved corners It has been suggested that the concentration of matter, originally uniformly distributed, into local condensations may have started this expansion To test this hypothesis, W H McCrea and G C McVittie (in *Monthly Notices Roy Ast Soc*, Nov 1930) study non stationary uni verses where there is a single condensation of matter at the origin This is proved to lead not to an expan sion as anticipated, but to a contraction Dr G C McVittie also contributes (*Proceedings* of the Edin burgh Mathematical Society, ser 2, vol 2, part 3 Jan 1931) a comparison between the general relativity theory and Einstein s newer unified field theory It is shown that the latter, applied to the problem of a particularly simple type of field with axial symmetry, gives results which do not appear to correspond to physical facts The conclusion can scarcely be evaded that Einstein's latest theory, at any rate in the form at present published, contains serious defects

Artificial Disintegration by α-Particles — The paper by J Chadwick, J E R Constable, and E C Pollard in the February number of the *Proceedings of the Royal Society*, in which they describe their new experiments on the disintegration of the nuclei of light elements by α particles and discuss these and the recent experi ments of Bothe and Fränz and of Pose, although leaving much detail still to be supplied, marks a definite advance in knowledge of the properties of nuclei The assumptions needed to explain such facts as are known at present are few and simple the nuclei are supposed to have definite levels for protons and α particles, to be composed of these and elec trons, the number of the α particles being as large as possible, all the α particles of a stable nucleus are supposed to be in the same energy level, but not more than two protons can be put into the same proton level Two main types of disintegration are supposed possible, in one of which the α particle is captured by the nucleus—as appeared to be so in the cases of the disintegration of nitrogen photographed by Blackett—and in the other, the proton is ejected without capture of the α particle The evidence for the latter type is rather unsatisfactory, but it is of particular importance, since the continuous distri bution of energies amongst the protons produced in this way could give immediately the level of the proton in the nucleus, disintegration with capture of the incident particle gives a line spectrum ' of velocities for the protons The changes in energy in volved in the disintegration, which can be calculated from these experiments, also extend Aston s measure ments of the mass defects of nuclei with the mass spectrograph, and in some cases furnish an inde pendent check on these, although most of the nuclei formed in the disintegrations have not been studied with positive rays, and many are indeed rare It is mentioned that the production of γ rays from light elements by α particle bombardment which was recently reported by Bothe and Becker (see NATURE, Feb 21, p 288), has also been detected by H C Webster in the Cavendish Laboratory

Solubilities in Hydrogen Fluoride —A comparison of the solvent properties of liquid hydrogen fluoride and of water with respect to salts is possible from some results with the first solvent, which are com municated in the January number of the *Journal of the American Chemical Society* by Bond and Williams The solubility of lithium hydrogen fluoride was measured between 0° and 40° Zinc, magnesium, and calcium fluorides were found to be very insoluble, chromium fluoride is quite soluble, potassium iodide reacts with hydrofluoric acid There is a fair similarity in the solvent action of water and hydrofluoric acid with the salts used A determination of the critical tem perature of hydrogen fluoride, made with a special apparatus, gave 230 2°

Conductivity of Electrolytes in Nitromethane and Nitrobenzene —The *Journal of the Chemical Society* for January contains two papers by Sir H Hartley, Murray Rust Hadow and Wright on the conductivi ties of some salts in nitromethane and nitrobenzene In the case of nitromethane only tetraethylammonium salts gave a linear relation between equivalent con ductivity and $\sqrt{c}$, and these also show good agree ment with the Debye Huckel Onsager equation All the other salts show large divergences from ideal behaviour Some of them are weak electrolytes in nitromethane, although they all behave as strong electrolytes in methyl and ethyl alcohols Since the dielectric constant of nitromethane is greater than those of the alcohols, the results show that ionic association is not entirely controlled by the electrical forces between the ions Perchloric acid is a fairly strong acid in nitromethane and the mobility of the hydrogen ion is 63 Thus this ion has not the abnormally high mobility in nitromethane which it possesses in hydroxylic solvents Other acids appeared to be very weak in nitromethane In nitrobenzene, tetraethylammonium picrate and perchlorate are strong electrolytes, and the results are in agreement with those calculated from the Debye Huckel Onsager equation, but silver perchlorate is appreciably associ ated Perchloric acid is an electrolyte of intermediate strength, and the mobility of the hydrogen ion is 43, which shows that it is not abnormal, as in hydroxylic solvents Hydrogen chloride, benzene sulphonic acid, and benzoic acid are very weak electrolytes Nitro benzene is similar to nitromethane as an ionising solvent, but the tendency towards ionic association is rather greater in the former The dielectric constants are 35 and 37 respectively

Resolution of *dl*-Menthol —NATURE, Mar 14, p 421 Last line but two of paragraph For ' *d* menthol" read '*l*-menthyl *d*-camphor 10 sulphonate"

Milk Tests in Lanarkshire Schools *

THE Department of Health for Scotland has recently issued a report on the investigation into the effect of the addition of milk to the diet of school children The data have been compiled and annotated by Dr Gerald Leighton, Medical Officer (Foods), and Dr Peter L McKinlay, Medical Officer (Statistics)

Twenty thousand children were concerned in the experiment, 10,000 being given a daily ration of milk and a like number being used as control subjects All the milk used was Grade *A* (Tuberculin Tested) Half of the milk was given in the raw state and half was pasteurised

The schools selected for the tests were all situated in the densely populated industrial part of the county While no account was taken of the distress prevalent in these localities in the selection, it has been estimated that one third of the children came from homes in which there was unemployment, complete or partial The ages of the subjects ranged from five years to twelve years The sexes were balanced in each age group

The teachers showed great interest in the experiment, and their "remarks" on the various subjects are often enlightening One teacher noticed that "in the playground buoyancy and pugnacity developed to an alarming extent" Another states that a little girl increased in vitality to such an extent that she boasted to her teacher of her ability to fight her big brother

While the physical benefits of the experiment made themselves fairly obvious, it was not easy to estimate the mental improvement However, many teachers have reported great improvements in mental alertness, especially among the younger children Others say that some of the children became drowsy One boy, who hitherto was very backward in reading, improved greatly and became very smart in reading, arithmetic, and history Another child, formerly very morose and sullen, has become bright and talkative

There are complete records of the progress of 17,159 children These records are in three parts—(*a*) Controls, (*b*) children fed with raw milk, (*c*) children fed with pasteurised milk These are further subdivided according to age and sex

Tables were prepared in such a way that not only the average increase in height or weight for the whole group, but also the average increase in height or weight for children of a given initial height or weight could be calculated In view of the fact that there were definite differences of weights and heights in the controls compared with 'feeders' at the beginning of the experiment, it was considered advisable to inquire whether the amount of growth within this period was affected to any appreciable extent by original physique that is, whether the heavier or taller child added more or less to its height or weight than the lighter or shorter child For this purpose coefficients of correlation between original weight and original height and change in height were calculated for the control group From these results it was inferred that there was no uniform tendency for gain in weight or height to be influenced by original weight or height

The conclusions may be summarised as follows

(1) The addition of milk to the diet of school children is reflected in a definite increase in the rate of growth, both in weight and height

(2) There is no obvious or constant difference in this respect between the sexes There is little evidence of definite relation between the age of the children and the amount of improvement The results do not support the popular belief that the younger children derived more benefit than the older children As manifested merely by growth in weight or height, the increase found in younger children through the addition of milk to the usual diet is certainly not greater than, and is probably not even so great as, that found in older children

INCREASE IN WEIGHTS (IN OUNCES) IN THE THREE GROUPS

Age	Boys			Girls		
	Control	Raw Milk	Pasteurised Milk.	Control	Raw Milk	Pasteurised Milk.
5	11 64	14 88	15 65	7 00	14 50	6 62
6	13 75	13 51	9 96	11 21	10 61	10 05
7	11 17	14 85	15 55	8 90	11 22	12 94
8	11 38	14 21	15 21	9 77	13 40	13 37
9	9 53	13 43	11 83	7 87	13 81	12 52
10	7 10	13 53	10 39	9 51	15 08	18 96
11	6 14	12 74	11 05	12 62	24 92	17 08

INCREASE IN HEIGHTS (IN INCHES) IN THE THREE GROUPS

Age	Boys			Girls		
	Control	Raw Milk	Pasteurised Milk	Control	Raw Milk	Pasteurised Milk
5	0 75	0 95	0 94	0 86	0 64	0 87
6	0 80	0·87	0 87	0 80	0 86	0 84
7	0 76	0 87	0 82	0 75	0 84	0 81
8	0 74	0 82	0 79	0 71	0 81	0 78
9	0 69	0 80	0 74	0 66	0 76	0 78
10	0 68	0 76	0 68	0 71	0 79	0 72
11	0 69	0 74	0 70	0 77	0 86	0 81

(3) In so far as the conditions of this investigation are concerned, the effects of raw and pasteurised milk on growth in weight and height are, so far as can be judged from this experiment, equal

Dr J P Kinloch, Chief Medical Officer of the Department of Health for Scotland, says, in a prefatory note, that the scheme was made possible by a grant of £5000 from the Empire Marketing Board, which approved its purpose and the selection of Lanarkshire for the experiment The Distress in Mining Areas (Scotland) Fund financed the experiment also, by a grant of £2000 Individuals and firms interested in the dairying industry contributed £477 The results, states Dr Kinloch, demonstrate that the addition of milk to the children's diet results in improved physique and mental alertness They also suggest that, apart from its own food value, milk enables the other constituents of the ordinary diet to be fully utilised as growth factors

It is significant that, by powers conferred by the Education (Scotland) Act, 1930, local authorities may make a ration of milk available for school children The exercise of these powers would, Dr Kinloch states, affect 800,000 children in Scotland, and, by improving their physical and mental well-being, would have a powerful influence in improving the quality of the Scottish race

JOHN TAYLOR

* Department of Health for Scotland Milk Consumption and the Growth of Schoolchildren By Dr Gerald Leighton and Dr Peter L McKinlay (Edinburgh and London, H.M Stationery Office, 1930) 3*d* net

Modern Metal Cleaning

THE increasing use of electroplating processes for the protection from corrosion, the reduction of wear, the building up of worn parts, or the actual manufacture of components, coupled with the fact that the production of an adherent metal coating depends on the complete removal of all foreign matter from the basis metal, makes an account of the means whereby this clean surface may be obtained by mass production methods one of considerable importance A paper on the subject was presented by Messrs L Wright and F Taylor to the Electroplaters and Depositors' Society recently

Cleaning tanks of steel, iron, or wood, with or without electrical connexions, still remain the most common means of achieving this end, and large volumes of cleaning solution, at a steady temperature, are required if the dirt is not to be redeposited on the work Such tanks may be heated by gas or by electrical immersion heaters, but a steam coil, placed at that side of the tank opposite the overflow dam, is the best This causes the solution to boil towards the dam, carrying with it surface scum or oil The coil should be shielded with perforated sheet metal, and the solution, gushing through the holes, effects adequate agitation For the general run of cleaning, the solution should be maintained at the boiling point, which has the incidental advantage that as the metal expands the dirt is loosened

Agitation by compressed air has the disadvantage that it rapidly cools the solution and promotes foaming In the absence of steam heating, the most convenient method for rapid and efficient cleaning is by an arrangement of paddles

Electric cleaning, which is rapidly coming into general use, adds a mechanical to the chemical effect The passage of the direct current though the solution liberates hydrogen in small bubbles at the cathode, forces the particles of dirt away from the metal, and carries them into the bulk of the solution, where they are readily emulsified and suspended The potential across the tank should be of the order of 6 volts, and the cathode current density 30 40 amp per sq ft Any danger of metals such as tin, lead, or zinc accumulating on the cathode may be eliminated after the cleaning by temporarily making the article the anode, this removes any such adherent film The accumulation of colloidal hydroxides can be avoided by the occasional use of supplementary steel electrodes, on which the colloidal hydroxides adhere The electrodes are from time to time removed from the bath and the accumulations scoured off

Effective rinsing after cleaning, in clean, soft water, is as important as the cleaning itself, as it washes away the dirt which the cleansing solution has loosened and softened Hard water reacts with the soap films forming a calcium soap, which adheres to the work The use of two tanks is recommended, the first hot and the second cold, and after rinsing, the article should be chemically clean, as shown by the surface being uniformly wetted

Meteorology in India *

THE year 1929–30 was one of exceptional expansion and reorganisation in the Meteorological Department of the Government of India, arising from the formation of new air-routes To meet the meteorological requirements of such air routes, and of additional contemplated air routes not yet in operation, as laid down in various international recommendations, it was found necessary to arrange for the preparation, twice daily, of weather charts at regional forecast centres, and to raise the status of most of the third class weather stations to second class status A new forecast centre in charge of a fully qualified meteorologist had to be opened at Delhi in November 1929 in order to supply weather forecasts to the State Air Mail and other aviators flying on the Jodhpur Delhi and Delhi Allahabad air routes, while the existing forecast centre at Karachi made itself responsible for forecasts for the Karachi Jodhpur route Further expansion was necessitated by the imminence of additional air routes from Delhi to Calcutta and Calcutta to Rangoon, and detailed proposals for meeting this need were submitted to the India Government

One of the most urgent needs of aviators is knowledge of the winds to be expected at various altitudes, in order that flying may be done with the maximum of wind assistance This has necessitated an increase of stations equipped for making observations of upper wind by means of pilot balloons, an increase which has reacted upon the organisation of the Upper Air Observatory at Agra, where the plant for producing the hydrogen required for the balloons is situated, an increase both of the plant and of the staff of that observatory has therefore become essential

All this activity on the side of organisation and equipment has not prevented useful research work from being done Many subjects have received especial attention, among which may be noted that of the electrical charge of thunder-clouds, which has resulted in observational support being found for Simpson's breaking drop theory Microseisms caused by earth tremors due to ocean waves have been studied in relation to the storms on the seas around India, and interesting relationships have been obtained, while the Upper Air Observatory at Agra has made a special study of the 'nor'-westers' that occur in Bengal in spring and early summer, a special expedition being organised in 1929 for this purpose These brief notes indicate only a few of the activities of a meteorological service that is rapidly pushing its way into the forefront of investigational enterprise

* Report on the Administration of the Meteorological Department of the Government of India in 1929–30 Pp 25+4 plates (Calcutta Government of India Central Publication Branch, 1930) 1 rupee, 1s 9d.

University and Educational Intelligence.

CAMBRIDGE —The Natural Sciences Tripos Committee has issued a report to the University and has made the following recommendations, to take effect after the examination to be held in 1933 (1) the examination in mathematics in Part I of the Natural Sciences Tripos shall be conducted by two special papers instead of by means of the papers set in Part I of the Mathematical Tripos The total maximum of marks allotted to mathematics shall be half that assigned to each of the other subjects, (2) all candidates for Part I of the Tripos shall be required to offer not less than three subjects exclusive of mathematics, (3) the subject mineralogy in Part I of the Tripos shall be redefined to include both crystallography and petrology It is also recommended that the written examination in mineralogy consist of two papers (1) the elements of crystallography, crystal optics, and descriptive mineralogy, (2) (a) crystallography and crystal physics, (b) crystal structure and crystal chemistry, (c) mineralogy and ore deposits, (d) petrology Two of these sections only are to be taken, with the restriction that (d) shall be taken only by students who offer also the subject of geology This report will be discussed next term

In NATURE of Mar 14, p 424, it was stated that Dr J Wishart had been appointed University lecturer

in statistics This is incorrect Dr Wishart has been appointed to the readership in statistics, to succeed Mr G Udny Yule Mr Udny Yule, formerly lecturer in statistics, was appointed reader on Jan 1 last, but he will vacate this post at the end of the present academical year A lecturer in statistics is to be appointed by the Faculty of Economics

EDINBURGH —The Senatus Academicus of the University has resolved to confer the honorary degree of Doctor of Laws, at the graduation ceremonial on July 2, on the following among others Dr E J Allen, Director of the Marine Biological Laboratory, Plymouth, Sir George Berry, M P for the Scottish Universities, formerly lecturer in opthalmology in the University of Edinburgh, Sir Walter Morley Fletcher, Secretary of the Medical Research Council

OXFORD —Congregation has accepted with thanks a gift of £200 from Mrs Clara Brooks in memory of her son, Clement C Brooks, formerly on the staff of the Imperial Forestry Institute, who was killed in a bicycle accident The interest of this sum is to be devoted to the purchase of entomological books and apparatus for the use of the Forestry Department

APPLICATIONS are invited by the Salters' Institute of Industrial Chemistry for a limited number of fellowships for chemists of post graduate standing The fellowships are each of the value of from £250 to £300 and their object is to afford additional and special training, at home or abroad, preparatory to a career in industrial chemistry The Institute is also offering a limited number of grants in aid to young men and women employed in chemical works in or near London, of 17 years of age and upwards, who desire to extend their education for a career in chemical industry Applications, in each case, should be made by May 1 at latest to the Director of the Institute, Salters' Hall, St Swithin's Lane, E C 4

THE March issue of the *School Science Review* devotes sixty pages to reports of the proceedings of the Science Masters' Association at the Birmingham meeting held early in January (see also NATURE, Jan 17, p 111) The presidential address by Sir Charles Grant Robertson, vice chancellor of the University of Birmingham, pleads the claims of biology to general recognition as an essential constituent in the school science curriculum The general principles of science cannot be imparted by instruction limited to physics, chemistry, and mathematics, and the omission of biology is stigmatised as a crime against science Sir Charles invited the Association to ask the Royal Society to appoint a small but representative committee to attack the problem of where, when, and in what system of allocation the teaching of science ought to begin and be carried on alike in the schools and the universities In a discussion on science education of the boy up to eighteen, Prof F W Burstall, vice principal of the University, pointed out that in competition with the other sciences, biology inevitably suffers from the handicap that it is generally believed to be not so likely to help a boy to earn a living when he leaves school A discussion on the subject of 'general science' disclosed a remarkable consensus of opinion in favour of the teaching of some biology to all pupils as an element of 'general' science, and an interesting description was given of a course arranged at Harrow as an introduction to science, occupying five periods weekly during one term Prof A W Nash, professor of petroleum technology in the University, addressed the Association on the work of the physicist and chemist in the petroleum industry, and the Bishop of Birmingham gave a lecture on "A Finite Universe?" The *Review* gives reports of both addresses

Birthdays and Research Centres.

Mar 22, 1868 —Prof A FOWLER, F R S, Yarrow research professor of the Royal Society and professor of astrophysics in the University of London, Imperial College of Science, South Kensington

In view of the considerable number of research students, an attempt is made to cover a wide field of spectroscopic research Continued attention is being given to the spectra of elements at successive stages of ionisation, and to the production and analysis of band spectra Some progress has also been made towards the establishment of standard wave lengths in the ultra violet and Schumann regions of the spectrum New work contemplated is the investigation of problems involving intensities and contours of spectral lines, and work on hyperfine structure, for which equipment has recently been provided

At present I am specially occupied with an investigation of the spectra of flames, in the belief that our present knowledge as to the molecular origins of numerous bands will throw considerable light on some of the processes of combustion

Mar 22, 1868 —Prof ROBERT A MILLIKAN, chairman of the Executive Council of the California Institute of Technology and director of the Norman Bridge Laboratory

I am still pursuing quite intensively my studies in the field of the cosmic radiations, for they have relations to meteorology not yet fully explored and their values at very high altitudes still have something to teach us about the precise nature of the cosmic atom building processes Also, as an adjunct to these studies, I am interested in the problem of the origin of the very heavy elements and, as a possible clue to its solution, am collecting further data, by a new method, on the terrestrial distribution of the radioactive elements Artificially stimulated radiations of high penetrating power are also a part of the programme

Mar 25, 1863 —Dr SIMON FLEXNER, For Mem R S, director of The Rockefeller Institute for Medical Research

The constantly growing number of those diseases of man, the lower animals, and plants, shown to be brought about by filterable agents or viruses, emphasises their known significance Among human beings, a disease of this character is poliomyelitis or infantile paralysis The modes of infection and of extension of the virus of this disease are questions of outstanding importance Ever since 1909, when the first serial transmission of the disease to monkeys was accomplished (Flexner and Lewis), these questions have commanded attention The indications, then secured and since confirmed, are to the effect that the virus is nerve conducted, as it enters and even as it leaves the body of infected human beings and animals via the respiratory mucous membranes

Not only is this finding of importance in so serious a disease as poliomyelitis, but corresponding questions are of high interest in connexion with virus diseases generally, as is also the question of the precise nature (chemical or otherwise) of the viruses themselves

Mar 27, 1855 —Sir J ALFRED EWING, K.C B., F R S, formerly principal and vice chancellor, University of Edinburgh, previously director of naval education and professor of mechanism and applied mechanics, University of Cambridge.

I am too old now for individual research But a long experience of laboratories and of administration

can still be turned to account in committee work of the kind that is increasingly done under such official bodies as the Department of Scientific and Industrial Research

I have learnt to value committees as instruments of research Often they achieve results which would otherwise be out of reach It has been said of them that they keep minutes and waste hours The jibe would be pointless if it did not contain a half truth But in fact, when sensible men serve on a committee, not much time is wasted One finds that in some kinds of research, especially in the application of science to industry, the directing is best done by a committee

In a committee, an old member, particularly when he happens to be in the chair can do much to check waste of time His very age becomes a useful asset It has developed his historical sense, it gives him a sort of authority He will focus attention on essentials He will explore the minds of his colleagues, collect their ideas, induce each to contribute and finally lead them to discover, perhaps to their surprise, that they are in agreement A committee is a fluid holding potential wisdom in solution, from which conclusions are to be crystallised out The process should not be hurried, but if, in the long run, a report issues which has some of the definiteness of a crystal, the time of the committee will not have been misspent

Societies and Academies

LONDON

Royal Society, Mar 12 – **E W Fish** On the reaction of the dental pulp to peripheral injury of the dentine A series of earlier experiments in which diffusible dyes were placed in the pulps of human teeth indicated that when primary dentine is injured at the periphery either by caries or attrition, the whole tract of affected tubules dies and becomes walled off from the pulp by secondary dentine The nature of the reaction is found to vary with the severity of the lesion The usual result is that the pulp ends of the injured tubules are sealed off by a deposit of calcium salts, and this is followed by a deposit of secondary dentine —**E B R Prideaux** The combination curves hydrogen ion regulating power, and dissociation constants of gelatin The properties of gelatin as an ampholyte have been deduced from the combination curves, in which pH is expressed as a function of added acid or alkali Considerable differences were noted between the combination curve of gelatin and those of amino acids By means of equations which express the simultaneous relations (*a*) absence of inflection at the isoelectric point, (*b*) the existence of the iso electric condition, the constants of the basic and acidic dissociations have been calculated on the assumptions that gelatin consists mainly (i) of un dissociated molecules, (ii) of amphoteric ions at its isoelectric point On either theory, three constants are obtained, of which one acidic and one basic constant are nearly equal to one another —**R Snow** Experiments on growth and inhibition Since it had been found previously (*New Phytologist*, vol 28, p 345, 1929) that in older and taller pea seedlings the young leaves near the apex inhibit the axillary buds near the base of the stem more strongly than in very young short seedlings, experiments were carried out to test whether the increase in strength of inhibition is due to the greater length of intervening stem It is concluded that the strength of inhibition increases with increasing length of intervening stem Axillary buds normally grow to a certain length before they are stopped by inhibition, and they are susceptible to inhibition during their early growth as well as later The interpretation of the increase of inhibition is briefly discussed —**C H Lea** The effect of light on the oxidation of fats A quantitative iodimetric method for estimation of the peroxide oxygen present in rancid fats is described By this means it is possible to follow the atmospheric oxidation of pure fats or of animal fats in the tissue, and, in conjunction with a suitable source of light, to forecast the relative susceptibilities of fats to oxidation This method, with a quantitative modification of the Kreis test, has been used to investigate the effect on the oxidation of fats —**H Munro Fox** and **H Ramage** A spectro graphic analysis of animal tissues Tissues of annelids, molluscs man, and some other animals have been studied Iron and copper were present in all kinds of protoplasm investigated Manganese was widely distributed The manganese content of tissues varies with the locality in which a given species of animal lives Nickel and cobalt occurred spasmodically, the former being more frequent Except in one case, all high concentrations of nickel were accompanied by cobalt In one tissue only did cobalt occur without detectable nickel Lead and silver both exhibit an irregular distribution (see also NATURE, Nov 1, 1930 p 682) – **A S Parkes** The reproductive processes of certain mammals (1) *Cricetulus* failed to breed under laboratory conditions but it was found possible to investigate the cyclic changes occurring in the non pregnant females, about half of which possessed perfectly normal reproductive organs The cycle is very similar to that of the mouse Cornification of the vaginal epithelium, diagnosed in the live animal by examination of the vaginal contents, was found to be associated with the period of ovulation The average length of cycle was a little under five days and the average number of follicles maturing at one period of ovulation was eight —**F G Spear** The delayed lethal effect of radium on tissue cultures *in vitro* –comparison of continuous and spaced radiation It was found to be immaterial whether the radiation was given in one dose of six hours or in six fractional doses of 60 minutes each at 24 hourly intervals

LEEDS

Philosophical and Literary Society, Dec 9 – **G J Blakey** The parabolic developable of the trinodal cubic surface The following results are due to Prof A E Jolliffe and W P Milne ' There is a sextic envelope $I_6 \equiv J_6 \quad U_2 I_4 = 0$ (where J_6 and I_4 are respectively the harmonic and equiharmonic envelopes of the plane quartic curve, and U_2 is a conic), which touches the 24 inflexional tangents of the quartic, and the 12 bitangents of a Steinerian Complex The conic U_2 is a sextangent conic of J_6, and there are 63 such conics corresponding to the 63 Steinerian Complexes " Dr Blakey has carried out the analo gous investigations in the case of a trinodal cubic surface —**E C Stoner** The specific heat of electricity in ferromagnetics The theory of the specific heat of electricity based on the application of the Fermi Dirac statistics is inadequate as it leads to values incorrect in magnitude and sign A metal is treated as an equilibrium distribution of atoms, ions, and free electrons It is shown that the observed change in the specific heat of electricity at the Curie point in nickel is consistent with the ferromagnetic properties —**G W Brindley** On the damping of the torsional oscillations of a sphere in a viscous medium An expression is developed for the damping of the tor sional oscillations of a sphere in a viscous medium from which the viscosity of the medium may be obtained The expression has been tested for water, but the observed damping is found to be 5–10 per cent greater than the calculated value —**J Duffey**

The electric beam discharge in argon Electron beam phenomena at low pressures are described, and space-potential measurements obtained by use of a cold exploring electrode given Certain parts of the discharge can be explained on the ordinary space-charge theory --**J E Taylor** Experiments on the efficiency of an electron gun An improved type of electron gun is described in which better focusing and higher beam efficiency are obtained by interposing between the emitting filament and gun muzzle a negative screen with a small central hole This screen has low negative potentials applied to it, and curves are given which show that maximum efficiency is attained at a certain screen potential which varies with the gas pressure The device resembles in its action the soft three electrode valve --**H M Dawson and E Spivey** The determination of catalytic co efficients from iso catalytic data Values for the coefficients which measure the catalytic activity of the non ionised acid (k_m) and the acid anion (k_a) may be derived from the minimum reaction velocities (iso catalytic velocities) which are observed when acetate buffers of the type $c\ CH_3CO_2H + x\ CH_3CO_2Na$, in which c is constant and x variable, are employed as catalysts for the reaction between acetone and iodine The experimental data for series of solutions with $c = 0\ 02$, $0\ 1$, and $0\ 5$ respectively and a 0 75 molar solution of sodium chloride as the reaction lead to values of $k_m = 1\ 3 \times 10^{-6}$ and $k_a = 3\ 3 \times 10^{-6}$ for the undissociated acid and the acetate ion (Temperature, 25°, acetone concentration, 20 c c per litre)--**J W Belton** The activity coefficient of a non electrolyte in aqueous salt solutions from solubility measurements Measurements of the solubility of *N* chloroacetanilide in aqueous solutions of sodium chloride, barium chloride, and magnesium sulphate show that the quantity of the anilide dissolved by 1000 grams of water is an exponential function of the ionic strength (μ) for each of these electrolytes up to $\mu = 4$ —**J Grainger and Edith Angood** The insect transmission of raspberry mosaic The mosaic disease of raspberries has been shown to have an insect vector in a species of aphid—*Aphis rubiphila* The mottling associated with the mosaic disease was induced in unmottled plants by caging aphids, transferred from a diseased cane, on the wild plants Untreated controls remained healthy, so the insect is deemed to be the transmitter - **R D Preston** The structure of the wall of *Valonia ventricosa* Recent X ray work has shown that the cellulose wall of the plant is built up of repetitions of anhydro glucose residues in a space lattice This lattice has a definite orientation with reference to the surface of the wall, but the data leave open the orientation of the anhydro glucose chains in the tangential plane As a result of investigations with the polarising microscope the wall of *Valonia ventricosa* is seen to consist of a mosaic of small areas, each with its own chain direction

PARIS

Academy of Sciences, Feb 2 —**V Grignard and L Lapayre** The β enynes and β diynes A study of the influence on an intermediate CH_2 group of two triple bonds or one double and one triple bond The hydro carbons $(C_6H_5)C\ C\ CH_2\ C\ C(C_6H_5)$, $(C_4H_9)\ C\ C\ CH_2\ CH\ CH_2$, and $(C_5H_{11})\ C\ C\ CH_2\ CH\ CH_2$ have been prepared and the acidity of the central CH_2 group examined by three methods, treatment with sodium, heating with sodium amide, and allowing to react with alkyl magnesium compounds —**Edmond Sergent A Donatien, L Parot, and F Lestoquard** The mode of transmission of North African bovine theilerosis by the tic *Hyalomma mauritanicum* The larva nymphs of *H mauritanicum* are infected by cattle carriers of *Theileria dispar* and, in the adult state, contaminate fresh cattle The *Theileria dispar* infection is not hereditary in the tic —Émile Cotton was elected *correspondant* for the section of geometry, and Sentiro Ikeno *correspondant* for the section of botany —**Chevalley** The relation between the number of classes of a sub body and that of a super body —**Paul Lévy** The maximum gain in the course of a game of heads and tails —**P Vincensini** A characteristic property of spiral surfaces —**J Doubnoff** The tensorial characteristics of certain classes of surfaces and of their networks —**V Lalan** The covariant derivatives of tensors —**V Romanovsky** The zeros of stocastic matrices —**Georges Valiron** A general property of meromorph functions —**Basile Demtchenko** Some bidimensional applications of the cavitational theory of Riabouchinsky —**Edgar Pierre Tawil** The electricity set free in quartz crystals by bending Detailed account of experiments on the electrical effects produced by bending quartz cylinders The results appear to be in contradiction with the conditions of symmetry of the crystal and with the laws of piezo electricity —**Benjamin Jekhowsky** A new expression of the *j* orientation of the great circle of asteroids —**R de Mallemann and P Gabiano** The magnetic rotatory power of the halogen derivatives of the saturated hydrocarbons in the gaseous state The figures given, together with those previously published, permit the approximate calculation of the atomic magnetic rotatory powers of hydrogen, carbon, chlorine, bromine, and iodine The rotatory powers of the ions in aqueous solutions are much greater than those of the corresponding atoms For the three halogen elements, however, the ratio of the Verdet constants is the same, about 3 2 —**Er Toporescu** The variation in the colour of cobalt chloride solutions At laboratory temperature, cobalt chloride in solution in methyl alcohol is rose violet, but in ethyl, *n* propyl, *n* butyl, and amyl alcohols it is an intense blue On lowering the temperature the colour changes from blue to pink in each case It is concluded that the change of colour of the solutions is a function of the dielectric constant and is caused by a change in the molecular condition of the solvent —**Mlle Suzanne Veil and L Bull** The microscopic and cinematographic study of Liesegang rings —**A Travers and Schnoutka** The separation of beryllium and aluminium A modification of Berthier's method, based on the precipitation of alumina with alkaline bisulphite —**M Tiffeneau and Mlle Jeanne Lévy** The benzoin condensation The influence of the nature of the radicals on the formation of mixed benzoins —**C Gaudefroy** New applications of an apparatus for measuring the angle of the optic axes —**Roger Heim** The phyletic connexions between the ochrospore Agarics and certain Gasteromycetes —**Maurice Hocquette** The influence of the substances secreted by the radicles in the course of formation on the nucleus of the neighbouring cortical cells —**O Munerati** Competition between *Ustilago Tritici* and *Tilletia Tritici* in the same wheat plant —**Mlle M L Verrier** The sensorial organs of some deep sea fish The results of the examination of a dozen specimens collected at depths of 2900 3000 metres It is difficult to find in these fishes a relation between the morphology of the sense organs and what is known of their mode of life and their habitat —**Raymond Hamet** 3 4-Dioxyephedrin and 3 4 dioxynorephedrin —**Tchang-Li** A new case of embryogenic condensation in a nudibranch (*Doridopsis limbata*) —**L Doljanski, J J Trillat, P Lecomte du Noüy, and An Rogozinski** The action of X-rays on tissue cultures *in vitro* The results of the experiments

prove conclusively that the idea of an exceptional resistance of cells cultivated *in vitro* is unfounded — Léon Velluz and Jean Loisleur The properties of proteocellulosic membranes —R Vladesco, D Simci, and M Popesco A new function of the stomach The rôle of this organ in the metabolism of urea — C Levaditi, P Ravaut, P Lépine, and Mlle R Schœn The presence of a virus pathogenic for the ape in certain venereal buboes of man

Official Publications Received

BRITISH

Journal of the Indian Institute of Science. Vol 13A, Part 12 I The Spike Disease of *Dodonaea viscosa*, by B N Sastri and N Narayana, II Studies in the Proteins of Indian Foodstuffs, Part 3 The Globulins of Bengal Gram (*Cicer arietinum*, Linn) and Horse Gram (*Dolichos biflorus*), by Nuggihalli Narayana. Pp. 147 158 (Bangalore) 12 annas

Records of the Geological Survey of India Vol 63, Part 4 Pp 379-450+ii+plates 10-19 (Calcutta Government of India Central Publication Branch) 2 12 rupees, 5s

International Geological Congress Compte rendu of the XV Session, South Africa, 1929 Vol 1 Pp xiv+314+42 plates Vol 2 Scientific Communications Pp x+688+97 plates (Pretoria Wallachs, Ltd) 40s

Board of Education Report of the Consultative Committee on the Primary School Pp. xxix+290 (London H M Stationery Office) 2s 6d. net.

The Carnegie Trust for the Universities of Scotland Twenty ninth Annual Report (for the Year 1929 30) submitted by the Executive Committee to the Trustees on 11th February 1931 Pp iv+94 (Edinburgh.)

Royal Society of Arts Report on the Competition of Industrial Designs 1930 Pp 52 (London)

Ollscoil Na h Eireann (The National University of Ireland) Calendar for the Year 1930 Pp viii+298+511+222 (Dublin)

The First Annual of the Pure Rivers Society 1930 Pp. 60 (London) 1s

An Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry Published for the Association of British Chemical Manufacturers Pp 24 (Cambridge W Heffer and Sons Ltd) 2s net

FOREIGN

United States Department of the Interior Geological Survey Professional Paper 100 The Coal Fields of the United States General Introduction, by Marius R Campbell Ohio by J A Bownocker Pp iv+101+9 plates. Professional Paper 160 Geologic History of the Yosemite Valley By François E Matthes. Pp vi+137+52 plates 1 10 dollars (Washington D C Government Printing Office)

United States Department of the Interior Geological Survey Water Supply Paper 623 Surface Water Supply of the United States, 1926 Part 3 Ohio River Basin Pp vii+343 50 cents Water Supply Paper 628 Surface Water Supply of the United States, 1926 Part 8 Western Gulf of Mexico Basins Pp v+207 35 cents Water Supply Paper 646 Surface Water Supply of the United States 1927 Part 6 Missouri River Basin Pp vi+216 20 cents Water Supply Paper 647 Surface Water Supply of the United States, 1927 Part 7 Lower Mississippi River Basin Pp iv+98 20 cents Water Supply Paper 648 Surface Water Supply of the United States, 1927 Part 8 Western Gulf of Mexico Basins Pp v+117 20 cents Water Supply Paper 655 Surface Water Supply of Hawaii July 1, 1926 to June 30, 1927 Pp v+151 25 cents (Washington, D C Government Printing Office)

United States Department of the Interior Fifty first Annual Report of the Director of the Geological Survey to the Secretary of the Interior 1930 Pp ii+91+1 plate (Washington, D C Government Printing Office.) 15 cents

Smithsonian Institution United States National Museum Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1930 Pp ix+219 (Washington, D C Government Printing Office) 35 cents

Institut de France Académie des Sciences Annuaire pour 1931 Pp 390 (Paris Gauthier Villars et Cie)

Calendario del Santuario e delle Opere di Beneficenza Cristiana di Pompei, 1931 Pp 272 (Pompei)

CATALOGUE.

Catalogue of Rare Books (No 82) Pp 71 (London William H Robinson, Ltd)

Diary of Societies.

FRIDAY, MARCH 20

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2 30 —Dr A C Thaysen Retrospects and Prospects of the Economic Application of Microbiology —H J Bunker A General Review of the Microbiology of Cellulose and its Associated Compounds.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.—Dr W Edgecombe and others Discussion on Osteoarthritis

LONDON SOCIETY (at Royal Society of Arts), at 5 —Lord Moynihan Ancient Methods of Surgery

PHYSICAL SOCIETY (at Imperial College of Science) (Annual General Meeting), at 5 —Presentation of Duddell Medal, 1930, to Sir J Ambrose Fleming

ROYAL SANITARY INSTITUTE (at Technical College, Lincoln), at 5 —L O Need and others Discussion on Houseboats on Inland Waterways —S C Baggott and others Discussion on Refuse Collection and Disposal

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith Demonstration of the Anatomy and Nerve Supply of the Diaphragm.

INSTITUTION OF MECHANICAL ENGINEERS at 6 —R S. Allen and W E. W Millington Modern Methods of raising Water from Underground Sources

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne), at 6.—T Millican Corrosion with Reference to Boilers

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (Informal Meeting), at 6 30 —W Lawson and others Discussion on Should the Bottom Bearings of Meters be Oiled?—W Holmes and others Discussion on Are Cobalt Steel Magnets Desirable for Use as Permanent Magnets for Instruments?—Lt. Col K Edgcumbe and F Hope Jones Discussion on Are Synchronous Motors or Clocks More Suitable for Time Service?—J W Record and W Phillips Discussion on Are Long Scales Preferable to Short in Indicating Instruments?

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers Hall E C) at 6 45 —Capt Whiteman Spray Dyeing

INSTITUTE OF CHEMISTRY (Manchester Section) (Annual General Meeting) (at 'Manchester Ltd , Manchester) at 7 —Prof R. M Caven Lecture.

INSTITUTION OF MECHANICAL ENGINEERS (jointly with Institution of Automobile Engineers) (at Merchant Venturers Technical College Bristol) at 7 —Dr I S. Davies An Experimental Investigation into Induction Conditions, Distribution and Turbulence in Petrol Engines.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College Newcastle upon Tyne), at 7 30 —H W Howes Pyrex Glasses their Properties and Uses

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —W S Roberts Some Token Systems of Railway Signalling

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section), at 8 30 —Dr Chalmers Watson Radiation in Relation to Human and Animal Life

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof E N da C Andrade Sound Sand and Smoke New Light on Old Problems

GEOLOGISTS ASSOCIATION (North East Lancashire Group) (at Technical College Blackburn) —J Ranson The Structure of the Alps (Lecture).

SATURDAY, MARCH 21

BRITISH MYCOLOGICAL SOCIETY (in Botanical Department University College), at 11 A M —Miss D Ashworth Development of Spores in Choanophoraceae —Miss M Brett Reversible Saltation in *Stemphylium* —P H Gregory The *Fusarium* Bulb rot of *Narcissus* —W M Ware Mushroom Growing Its Scientific and Practical Aspects

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire and North Western Districts) (at College of Technology, Manchester) at 2 30 —Dorman Long and Co Ltd The Building of the New Tyne Bridge, The Building of Imperial Chemical House and The Sydney Harbour Bridge

MATHEMATICAL ASSOCIATION (at Bedford College) at 3 —S Inman Contracted Methods in Arithmetic

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Lord Rutherford Recent Researches on the Alpha Rays (3).

RURAL RECONSTRUCTION ASSOCIATION (at 26 Bedford Square) at 3 —R. Borlase Matthews The Importance of Electrical Development to the Countryside —M Fordham Marketing and Employment

MONDAY, MARCH 23

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —R T Payne Demonstration on Pathological Specimens Relating to Diseases of the Gall Bladder and Extra hepatic Biliary Passages

INSTITUTION OF MECHANICAL ENGINEERS (Annual Meeting) at 6 45 Short Papers

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne), at 7

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7 —J W Rissik and H Rissik Heavy Duty Rectifiers and their Application to Traction Substations

INSTITUTE OF FUEL (at Institution of Civil Engineers), at 7 30 —R A Burrows Self help in the Coal Industry

BRITISH KINEMATOGRAPH SOCIETY (at Film House Wardour Street), at 7 45 I Rowson Some Aspects of Camera Work in Hollywood

ROYAL SOCIETY OF ARTS, at 8.—Capt. A G D West The Recording and Reproducing of Sound (Cantor Lectures) (3)

ROYAL SOCIETY OF MEDICINE (Odontology Section) at 8 —Clinical Meeting

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 —Dr C Christy Liberia in 1930

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Annual General Meeting) (at Leeds) —H J Pooley and others Discussion on the Activities of the Society

TUESDAY, MARCH 24

ROYAL SOCIETY OF ARTS, at 4 30 —Dominions and Colonies Meeting

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 —Dr Janet Vaughan Dr S C Dyke Dr J F Wilkinson and others Discussion on The Value of Liver in Treatment

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5 —Sir William Willcox Toxic Jaundice (Lumleian Lectures) (2)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr C D Darlington The Cytological Theory of Heredity and Variation (3)

EUGENICS SOCIETY (at Linnean Society), at 5 30 —W Palin Elderton Heredity and Insurance.

INSTITUTION OF CIVIL ENGINEERS, at 6 —G C Minnitt The Washaway and Reconstruction of the Nerbudda Bridge on the Great Indian Peninsula Railway —The late P Allan The Georges River Bridge, New South Wales

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 — R Appleyard Michael Faraday

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole Leeds) at 7 —E S Ritter Picture Telegraphy

INSTITUTION OF ELECTRICAL ENGINEERING (North Western Centre) (at Engineers Club, Manchester) at 7 — C E R Bruce The Distribution of Energy liberated in an Oil Circuit Breaker, with a Contribution to the Study of the Arc Temperature

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel Edinburgh), at 7

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent Glasgow) at 7 30 — O Short Design and Construction of Marine Aircraft

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street W 1) at 7 30 — Gossip Meeting

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street Sheffield), at 7 30 —J D Hannah Some Notes on the Selection and Examination of Materials for Driving Chain Manufacture

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society) at 8 —C F Hammond The Concentration of Phosphoric Acid Solutions by Means of the Submerged Flame

ROYAL ANTHROPOLOGICAL SOCIETY at 8 30 —G D Hornblower Temples and Kings of Ancient Egypt

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub Section) (at University College, Nottingham) —W J Webb The Architectural Requirements of a Modern Electric Home

INSTITUTE OF BREWING (Scottish Section) (at Caledonian Hotel, Edinburgh) —Dr R H Hopkins Physical Chemistry of the Proteins and some Applications to Brewing Problems

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) — Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture)

WEDNESDAY, MARCH 25

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5

INSTITUTION OF CIVIL ENGINEERS (Students Meeting) at 6 30 — J M Liddell Recent River wall Construction on the Thames

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers Club Manchester) at 7 — J E Arrowsmith Pressings for Automobiles

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees Side Branch) (Graduate Section) (at Cleveland Scientific and Technical Institution Middlesbrough) at 7 — A Brown The Construction of the Airship Base in Ismalia

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall Newcastle on Tyne), at 7 15 — *Debate That the Present Depression in the Engineering Industry is Largely Due to Inefficient Sales Organisation*

INSTITUTE OF CHEMISTRY (Belfast and District Section) (at Royal Belfast Academical Institution) at 7 30 —R T Shepherd Absorption of Gases in Electrical Discharge Tubes

ROYAL SOCIETY OF ARTS at 8 —Prof P Abercrombie The Kent Coalfields

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London), at 8 30 —Dr M F J Lowenfeld A New Approach to the Problem of Psychoneurosis in Childhood

THURSDAY, MARCH 26

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5 — Sir William Willcox Toxic Jaundice (Lumleian Lectures) (3)

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 Prof J B S Haldane Respiration (6)

ROYAL SOCIETY OF MEDICINE (Urology Section) at 5 30 —Prof A von Lichtenberg The Principles and New Advances in Excretion Urography

OPTICAL SOCIETY (at Imperial College of Science and Technology) at 5 30 —T Smith (*a*) Secondary Conjugate Surfaces (*b*) Graphical Constructions for a Refracted Ray —A Whitwell Fused Bifocal Spectacle Lenses

INSTITUTE OF FUEL (South Wales Branch) (at South Wales Institute of Engineers Cardiff) at 6 — Major E Ivor David Local Generation of Electrical Power plus the Grid

INSTITUTION OF ELECTRICAL ENGINEERS at 6 — R Grierson The Electrical Heating of Buildings

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology) at 8 —Dr M Drury Smith The Idea of the thing as a whole in Certain Forms of Learning

FRIDAY, MARCH 27

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (at Middlesex Guildhall, Westminster) at 3 —Annual Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre) (at Electricity Offices, Swansea), at 6

INSTITUTE OF FUEL (East Midlands Section) (at Technical College Derby) at 7 P H N Ulander The Power Consumption of Boiler house Auxiliaries

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 7 — Exhibition of Industrial Kinematograph Films

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —C E Prince Light Sensitive Work in Modern Industry

GEOLOGISTS ASSOCIATION (in Architectural Theatre, University College) at 7 30 — Prof L S. Palmer On the Pleistocene Succession of the Bristol District E M Venables Notes on the Geology of Felpham, near Bognor Regis

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8 —Dr A F MacCallan Trachoma its Importance as a World wide Disease

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Lord Rutherford Helium and its Properties

SATURDAY, MARCH 28

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Lord Rutherford Recent Researches on the Alpha Rays (4).

PUBLIC LECTURES.

SATURDAY, MARCH 21

HORNIMAN MUSEUM (Forest Hill), at 3 30 — J E S Dallas Peasant Life in Alpine Districts

TUESDAY, MARCH 24

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 15 —Dr C H Andrewes Immunity in Virus Diseases (2).

THURSDAY, MARCH 26.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5 15 —Prof Major Greenwood Nerves and the Public Health (Chadwick Lecture)

SATURDAY, MARCH 28

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Prof J R Ainsworth Davies Fur bearing Animals in Canada

CONFERENCES

TUESDAY, MARCH 24

CONFERENCE ON THE PLACE OF SHEEP IN MODERN FARMING (at Rothamsted Experimental Station, Harpenden) at 11 30 A M —Chairman J Egerton Quested Speakers F A Thomson, J R Wood, A Lewis J Joyce Major V S Bland, H Edgar H W Drewitt, A C Hill, H G Miller

SATURDAY AND MONDAY MARCH 28 AND 30

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Edinburgh)

Saturday March 28 (In Department of Zoology)

10 A M to 1 P M —J Hammond The Life of the Unfertilised Ovum

A J M Smith The Problem of the Vitelline Membrane (*a*) Gas Exchange and Osmotic Equilibria of the Infertile Hen s Egg

J Needham M Stephenson and D M Needham The Problem of the Vitelline Membrane (*b*) Lactic Acid Production in the Infertile Hen s Egg

J Needham The Problem of the Vitelline Membrane (*c*) The Osmotic Properties of the Isolated Membrane

H O Bull Conditioned Responses and Salmon Smolts

W H Pearsall and M Pilling The Physiology of Storage in the Apple

E C Barton Wright The First Sugar of Photosynthesis

(In Department of Animal Genetics)

2 15 to 3 45 —*F A. E Crew and L Mirskaia* (*a*) Genetic and Physiological Studies on the Hairless Mouse (*b*) Observations on the Aged Male and Female Mouse

B P Wiesner P G Marshall J M Robson H Taylor and R E Illingworth Recent Experiments on the Dynamics of the Sex Cycle

3 45 to 5 30 —Demonstrations

5 30 to 6 30 —E Boyd Experiments on Skin Transplantation in the Mouse

E M Gilroy The Effect of Arginine and Thyroxine on the Growth Rate of a Transplantable Tumour of the Mouse

Monday March 30 (In Department of Bacteriology)

10 A M to 12 15 P M — I J Blake Experimental Infection of *Salmo fario* by *Bacillus salmonicida*

A Cunningham and T Gibson Recent Work on the Filterable Gonidial Stages of Bacteria.

J J Mackie M H Finkelstein and H J Gibson The Natural Antibodies of Various Animal Species

J M Alston Analysis of Antigens on the Basis of Chemistry and Function

M H Christison Microbic Dissociation with Special Reference to the Tubercle Bacillus

12 15 to 1 —Demonstrations

(In Department of Zoology)

2 15 to 3 45 — A Walton Gas Storage of Mammalian Spermatozoa

A L Craig Bennett Observations on the Influence of Temperature on the Breeding of Animals

A Graham Temperature and *p*H Optima of Invertebrate Enzymes

3 45 to 4 30.—Demonstrations

4 30 to 6 —J W Gregor Experimental Methods in Taxonomy

V E McM Davey Inheritance of Colour in Certain Species of *Brassica*.

W Black Inheritance of Colour in the Potato Tuber

ANNUAL MEETING

MARCH 25, 26, AND 27

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts).

Wednesday, March 25 at 10 30 A M —Lord Wester Wemyss Presidential Address

Sir Archibald Hurd British Sea Power, 1900 1930

M F Hay The Maierform of Hull Construction

Thursday March 26 at 10 30 A M —Sir Charles J O Sanders The Establishment of an International Load Line

J Foster King International Load Lines

L C Burrill Seaworthiness of Collier Types

At 2 30 —Prof W Hovgaard A New Theory of the Distribution of Shearing Stresses in Riveted and Welded Connexions and its *Application to Discontinuities in the Structure of a Ship*

F H Todd Further Model Experiments on the Resistance of Mercantile Ship Forms - Coaster Vessels.

Friday, March 27, at 10 30 A M —Dr H H Blache The Present Position of the Diesel Engine for Marine Purposes

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W H Howden Some Modern Examples of Air Heaters

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SATURDAY, MARCH 28, 1931

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No 3204, Vol 127]

University Entrance Scholarships for Science.

AT the Headmasters' Conference last December the following resolution was passed, with only four dissentients

"That this Conference regrets the degree of specialisation which the Science Scholarship Examination papers at Oxford and Cambridge demand from candidates, and wishes

(1) that in all Science Scholarship Examination papers the General Paper should be given a definite value, and

(2) that at least some Science Scholarships could be offered for which a less specialised course of Science would be required"

Recent correspondence on this subject in the *Times* points to the existence of an educational problem, but fails to produce any satisfactory solution Mr Fletcher, headmaster of Charterhouse and chairman of the Headmasters' Conference, deprecates the fact that boys who cannot afford to go to the university without a scholarship, often the best material at the start, are forced prematurely into an undesirably narrow groove, and implies that thus the probable future leaders of science are being brought up as "illiterate and premature specialists" He offers no constructive suggestion to remedy the evil, but hopes that university authorities may by his very importunity be urged to take action

In defence of Oxford, Mr C N Hinshelwood, of Trinity College, points out that in the examination held by a group of nine colleges, candidates must (1) offer at least three subjects selected from chemistry, physics, zoology, botany, mathematics, (2) take a paper in which are set passages for translation from four languages, (3) do a general paper, to which a very definite value is attached His account of the principles observed in making the awards renders it difficult to conceive how the examination could be improved

From Cambridge, Mr J T Saunders, of Christ's College, champions the educational value of science rightly taught, and directs attention to the importance of personal, as distinct from tutorial, influence in stimulating general culture

Among other correspondents, Dr F A Bather advocates that future endowers of scholarships should give the money to the schools and not to the colleges, Mr Knight, until recently headmaster of Sexey's School, Bruton, urges that the universities should reserve a fair proportion of available scholarships for candidates who have covered a wider curriculum, as indicated in paragraph (2) of the

Conference resolution, Prof A V Hill, admitting the disease and the difficulty of curing it, politely hints that the classical pot is every whit as black as the scientific kettle, and so on

It is generally admitted that, especially in chemistry and physics, the papers now set are of a more advanced character than was the case, say, twenty years ago But the improved equipment of school laboratories and the increase in the number of science masters per school render possible, nay, justify, the attainment of a higher standard of work at schools Moreover, natural science is essentially progressive The discoveries made during the present century have profoundly modified our ideas both in biology and in physical chemistry, and it is right that the rising generation be taught to view each subject in the light of the most recent knowledge Probably no school permits its pupils to specialise in any direction, scientific or other, until a school certificate examination has been taken This examination, though elementary, does at any rate ensure a certain minimum of general education, and by the time a pupil takes it his capacity for profiting intellectually by specialisation in a particular direction ought to be fairly evident

It must not be forgotten that all minds are not cast in the same mould, and that all do not mature at the same rate Some there are who, about sixteen years of age, show marked ability in classical and literary subjects and yet are complete failures in natural science Conversely, there are those who, by sheer perseverance in the uncongenial deserts of most of the compulsory subjects in the school certificate examination, at length reach the promised land and find their *métier* in one or more of the scientific subjects Similarly, those wide interests which constitute culture make no appeal to some, be they never so temptingly put before them—a silk purse was never yet made from a sow's ear, but why should the community be deprived of the good leather that it is capable of yielding? The boy who is, unfortunately, gifted in only one direction should surely be allowed to pursue it to the full

It is perhaps a counsel of perfection to urge that school curricula should be so wide as to afford to every pupil the opportunity of sampling many subjects, and thus of finding out where his true interests lie, though the personality of the teacher often goes far towards determining this Nevertheless, within the limits of the school certificate subjects, it should be possible to ensure logical thinking and ability to express thoughts and to describe facts in clear, concise, grammatical English, nor ought teachers in specialised, post-certificate subjects to permit written work to be presented in slipshod, illiterate form

There are several ways by which the cultural outlook of specialist pupils may be enlarged school societies debating, literary, musical, travel, and the like—all tend to prevent excessive narrowness, while short courses of lectures on, for example, great artists, musical composers, architecture, exploration, and so on, need make no violent inroads into the time-table, and yet serve to awaken interests the existence and quality of which can be tested in the general paper to which the Headmasters' Conference wishes a definite value assigned

What this value should be is not easy to decide Good essays in the general paper are known to have determined the award of science scholarships when there was little to choose between the scientific attainments of competing candidates But can it be maintained that a candidate who is *facile primus* in the science papers should be disqualified from election by a poor performance in the general paper?

Clause (2) of the resolution of the Headmasters' Conference presents practical difficulties "A less specialised course of Science" presumably connotes at least two subjects of the usual three, biology, chemistry, and physics, taught in schools Biologists are bound to have some preliminary teaching in both the other subjects, so it would not appear unreasonable to demand of them in scholarship examinations a knowledge of the elements of chemistry and physics It is, however, almost impossible for boys offering chemistry and physics to include biology in their *repertoire* Physics, other than elementary, demands considerable mathematical efficiency, hence the boy who selects physics as one of his subjects must make full use of the hours allotted to mathematics Biology is thus crowded out of his time-table

So long as competition exists, examiners will be prone to set questions on topics near the upper limit attainable by the candidates concerned, though it is sometimes possible to discriminate between candidates by means of relatively easy questions, allowing wide scope in the quality of the answers If representatives from the universities and from the Science Masters' Association could agree on reasonably high boundaries beyond which no question is to be set in scholarship examinations for, say, the next ten years, and if the universities would appoint moderators to supervise the papers proposed by college tutors for scholarship examinations in order to secure that the questions lie within the agreed limits, perhaps the Headmasters' Conference would find less to deplore

Chemistry in Three Dimensions

Stereochemie Von Georg Wittig Pp xi+388 (Leipzig Akademische Verlagsgesellschaft m b H, 1930.) 25 gold marks

THE centenary of Kekulé's birth was celebrated in September of 1929, and many chemists who were present on that interesting occasion welcomed the opportunity which Prof Pfeiffer gave them of inspecting those old models with the black ball attached to four metal rods directed towards the corners of a regular tetrahedron Those were, in fact, the identical models upon which the youthful van 't Hoff had gazed with wonder, and which doubtless contributed in no little measure to the inspiration which the old university town gave him, for van t Hoff cherished to the end a love for Bonn "In Leiden", he wrote, "war alles Prosa, die Umgebung, die Stadt, die Menschen In Bonn, alles Poesie!" During van 't Hoff's sojourn in Bonn in 1872–73, Kekulé had already gathered round him a band of enthusiastic workers, including men like Franchimont, Spring, Wallach, and Zincke, but the independent Dutchman did not display the slightest inclination to join this illustrious circle, and thus, naturally enough, Kekule lost interest in him So off to Wurtz and to Paris, but the seed for one of the greatest conceptions in chemistry had fallen on fertile soil

Since the formulation of the doctrine of the asymmetric carbon atom by van 't Hoff and Le Bel in 1874, the progress of stereochemistry with all its ramifications has been so rapid and so well sustained that it is an impossible task in the brief scope of some 400 pages to give any account of these advances which can be at once comprehensive and adequate Dr Wittig has frankly recognised this difficulty The literature published after 1904—the date of the appearance of Werner s "Lehrbuch der Stereochemie"—is dealt with in much greater detail than is the earlier work, and in order to effect further economy of space, many branches are perforce either omitted altogether or scarcely mentioned at all Fortunately, an account of the progress of the study of the Walden inversion is given by Walden himself in his "Optische Umkehrerscheinungen", and chemists who are interested in this problem should consult this résumé Thus, by dealing very briefly with certain fundamental problems, the author has allowed himself ample space for other sections, notably those concerned with co-ordination compounds and with crystal structure Indeed, the account of Werner's brilliant researches is altogether admirable, and it is written with remarkable clarity Incidentally, mention is made of that unique optically active compound containing no carbon and having $[M]_{5600}$-47,000°, a high value which should appeal to those chemists who quote molecular rotations

Dr Wittig shows too little discrimination in sifting those aspects which are really important from those which are merely trivial It would be easy to give many examples in support of this criticism, but one may suffice The introduction of the camphor sulphonic acids for resolving externally compensated bases proved in the hands of Pope to be an experimental contribution of outstanding service Not only did it enable him to break entirely new ground in the stereochemistry of nitrogen, sulphur, and other elements, but also Werner and many others who followed later would have been seriously incommoded if the application of those camphor acids on the part of the English investigator had not paved the way The references on pp 37 and 169 scarcely suggest that Pope s contribution had any value at all This is one reason why this book should not be placed in the hands of a beginner, who might also miss the romance engendered by a close survey of the earlier history Why, for example, should that dramatic episode of the conversion of the sceptical Biot by Pasteur be omitted? It is an old story which can be told again and again without losing its charm

I find throughout Dr Wittig s book a distinct lack of balance in the whole treatment, the picture is presented all too often out of its proper perspective For example, in no country more than in Great Britain has the study of optically active compounds been prosecuted with greater zeal, but we look in vain for an adequate recognition of the contributions of those pioneers, Purdie and P F Frankland Purdie's name is not even mentioned, although the resolution of lactic acid by the addition of a nucleus of *d*- or *l*-zinc ammonium lactate to a supersaturated solution of the inactive double salt is an unusual and an elegant method which still remains the most practical one for preparing the optically active lactic acids by the kilogram Purdie's methods of resolving lactic and alkyloxypropionic acids by alkaloids, as well as Frankland's resolutions of glyceric acid, are models of exact experimenting which, even in these days of hurried publication, could be read and imitated with very great advantage by those who wish to obtain their substances in a condition of optical purity Nor is there any reference to those experiments on optically active esters which led to the discovery of the silver oxide

method of methylation, which has proved its value (in the hands of Irvine and others) in the chemistry of carbohydrates Again, less than justice is done to Frankland's comprehensive work on the connexion between optical activity and chemical constitution, and to the work of his pupils, Patterson and Pickard, in the same field

It is a matter of some regret that Dr Wittig has, for lack of space, so little to tell us about the application of stereochemical ideas to enzymatic actions The reader will, therefore, have to go elsewhere if he wishes information on work such as that of Neuberg, for example We miss a reference to the ingenious experiments on asymmetric reduction and dismutation, and on the formation of phenylacetyl carbinol by the addition of benzaldehyde to a sugar in the process of undergoing fermentation Whether the equation

$$C_6H_5\ CHO + CH_3\ CHO = C_6H_5\ CH(OH)\ CO\ CH_3$$

can be accepted for the latter action is a matter for debate, but in any event the asymmetric formation of the lævorotatory ketol by the enzyme carboligase is an observation of striking originality, and one which emphatically should find a place in every modern text-book of stereochemistry

A few mistakes have been noticed , for example, on p 21 *Bacillus œthalticus* should be *Bacillus ethaceticus*, and on p 63 $C_{10}H_9$ should be $C_{10}H_{19}$ The scheme at the top of p 53 is incomplete, the conversion of the amino alcohol into the ketone not being indicated, whilst the real point of interest, namely, the retention of optical activity during the semipinacolinic changes from the amino alcohol and the glycol, is missed altogether The asymmetric synthesis of mandelic acid was never effected as described on p 40 The statement on p 169 that Le Bel obtained the optically active methyl-ethyl-propyl isobutyl ammonium chloride is incorrect , the first quaternary compound of this type was prepared by Pope in 1899

In the index and throughout the text the names of authors should be revised , designations such as B Cohen, O Forster, A Guye, F Landolt, H Perkin, S Patterson, F Frankland, etc , enable us to recognise the authors, but they have a strange ook !

In spite of some defects, this book can be commended most cordially to those who are not actually beginners in the study of stereochemistry Dr Wittig has given us by far the best account of this subject which has been published within the past twenty-five years, and we ought to be very grateful to him ALEX MCKENZIE

Star Clusters and the Galaxy

Star Clusters By Harlow Shapley (Harvard Observatory Monographs, No 2) Pp xi + 276 + 3 plates (New York McGraw-Hill Book Co , Inc , London McGraw-Hill Publishing Co , Ltd , 1930) 15*s*

IN 1915–18, Dr Shapley published a remarkable series of researches on globular clusters which brought these remote objects into the forefront of astronomical interest His results indicated an extension of the flattened system of the galaxy about ten times greater than had previously been adopted This was the beginning of a phase in astronomy which its critics might describe as megalomania The same method has since been applied to the still more distant spiral nebulæ, and these have tended to displace the globular clusters in their appeal to our imagination From the observational point of view, however, there is no comparison between the stage of advancement of the two subjects As regards the spirals, our systematic knowledge is summed up in a fairly trustworthy calculation of the size and distance of three or four of the nearest of them, a guess at the distances of the remainder, and the astonishing fact that almost without exception they are running away , as regards the star clusters, we have before us Shapley's monograph, closely packed with statistics and individual studies, with a wealth of problems and deductions which interact with and illuminate our knowledge of the stars in our immediate neighbourhood

In the bibliography at the end of the book, Shapley's share amounts to 150 papers It was time, therefore, that he should make this attempt to consolidate the gains to knowledge during fifteen years of assiduous research Primarily the book is a mine of information where we may find set forth the latest position with regard to the innumerable problems which the study of star clusters has provoked One of the most intriguing features of the work, recognised at the outset, has been that in some respects our knowledge of the distribution and statistics of stars in these systems 10,000-50,000 parsecs away may be much more advanced than our knowledge of the stars at less than 100 parsecs distance The reason is that the distances of the nearer stars are found individually with great labour and uncertainty, whereas in observing a globular cluster a single determination of distance applies to the whole system The principal method of finding the distance is by measuring the apparent magnitude of the Cepheid variables

contained in the cluster, comparing the apparent magnitude with the known absolute magnitude of a Cepheid of the same period, the distance is obtained immediately, provided that absorption of light in interstellar space in inappreciable The method was first used by Hertzsprung to find the distance of the lesser Magellanic Cloud Shapley has found the distances of twenty out of the ninety known globular clusters in this way Distances of the remainder are estimated by more doubtful procedure Shapley uses distances determined by either method promiscuously We think this is unfortunate, for even if the validity of the less direct methods is admitted, it is clear from his own diagrams that the distance obtained for an individual cluster is very rough, and its value is mainly statistical

The assumption that the light of the globular cluster suffers no important absorption in reaching us is probably legitimate, but the monograph may give an undue impression of the strength of the evidence Actually the main evidence for transparency (none too strong) is outside the scope of the monograph, being based on our general knowledge of the density and state of the interstellar cloud Shapley showed that the light coming from star clusters is not reddened by scattering, and thus settled a long outstanding question but with our present knowledge, both observational and theoretical, that interstellar matter is ionised, we cannot infer absence of absorption from absence of reddening In short, Shapley's observational fact (absence of reddening) is countered by another observational fact (existence of ionisation) and the problem reverts mainly to theoretical investigation Further, we know that about two per cent of the sky is covered with opaque matter, and although there appears to be in general a rather sharp transition from complete opacity to nearly perfect transparency, it will be fortunate if all the ninety clusters escape the transition zones

There is a startling heading to §51, "A Theoretical Period-Luminosity Relation for Galactic Cepheids" There is a theoretical period-density relation described elsewhere in the book, but hitherto theory has been baffled to find any explanation of the period-luminosity curve, which is a quite independent correlation On examination, we find that the heading has no real justification, and the section deals with the relation of the period-luminosity curve to another equally empirical curve, in fact, the argument has gone round the circle, since the data embodied in these two empirical curves were used to verify the original period-density relation The comparison of "observed and theoretical period luminosity relations" on p 148 is an alternative way of presenting the more usual comparison of the observed and theoretical period-density relations

Shapley concludes that the minimum diameter of the galactic system is 70 kiloparsecs, with a thickness about one-tenth as great Our distance from the centre is about 16 kiloparsecs, this is in satisfactory accordance with estimates ranging round about 10 kiloparsecs based on the phenomenon of galactic rotation I see no escape from dimensions of this order, yet it raises a difficult question when we come to compare the galactic system with the spiral nebulæ I think it was Shapley who remarked that if the spirals are 'island universes' our galaxy is a 'continent' The discrepancy in size between our galaxy and the external galaxies cannot be attributed to errors in the determination of the distances, for the same method is used for both and a systematic error would expand or contract them equally If absorption of light in space is appreciable, the discrepancy becomes still greater

Shapley now proposes the view that our system is not a single spiral but comparable with the clusters of spirals in Coma Virgo and in Ursa Major, this reverses the difficulty, for their dimensions appear to be much larger than those of the galaxy If we accept this view, we have to disregard the evidence of galactic rotation, the observed rotation is of differential type which would quickly shear any individual sub-system, and it cannot be interpreted as rotation of a number of separate star-clouds round a common centre We can only wait for further light on this perplexing problem

A S EDDINGTON

Biology and Human Life

The Science of Life By H G Wells, Julian Huxley and G P Wells Pp xvi + 896 (London, Toronto, Melbourne and Sydney Cassell and Co, Ltd, 1931) 21s net

THIS is in several ways a remarkable book, as its authorship would lead us to expect, for it gives us in one volume a competent comprehensive survey of the whole of biology—physiological, morphological, embryological, and evolutionary, it is written so that it can be 'understanded of the people' and with a sparkle that engages the attention, and it is one of the few books, heralded by Sir Richard Gregory's "Discovery", which make the reader feel that science is not only for illumination,

N 1

but also for "the relief of man's estate", as Bacon phrased it If, as we believe, mankind is at the dawn of a new era—the biological era, when an all round appeal will be made to the biological sciences, as already to the physical, for guidance in the control of human life—then the big book of Wells, Huxley, and Wells will come to be regarded as an instalment of the relevant 'Law and Prophets' Along with biology, we are, of course, including psychology, for these two sciences are becoming almost as inseparable as chemistry and physics No doubt the last scientific word will be with sociology, but that science, though born two millennia ago, has not yet come of age

It may be said that the appeal to biology began very long ago when the early patients sought the aid of the early physicians, but this was an appeal to an art rather than to a science For, while many of the physicians, from Hippocrates and Galen onwards, were biologically minded in a high degree, biology is a modern science and a widespread appeal to biology as a science is still incipient The recent establishment of a professorship of social biology in the University of London is a natural supplement to a eugenics laboratory, both expressing a movement of which Galton and Pasteur were pioneers Thus, while we appreciate "The Science of Life" for its wide reach, its educative lucidity, its fair mindedness, its freshness of presentation, its arresting figures, and so on, we appreciate it most because the authors have had the courage of their convictions and have not hesitated to proclaim, as their particular gospel, that the utilisation of biological knowledge can do much to save man amid his sea of troubles We do not mean that this book stands alone in this respect, but it is perhaps the largest comprehensive treatise in which 'biology for life' is a dominant note Cowdry's "Human Biology and Racial Welfare" (1930) is, to our thinking, a fine collection of specialised propagandist tracts, but the book before us is a treatise on biology, written primarily for the scientific instruction of the people, yet ever sounding the note of practical applicability It would have pleased T H Huxley, who was so clearly convinced of the indispensableness of applying science to life, declaring "that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is" The same idea was finely expressed in a convincing address on Jan 23 last by Sir Walter Morley Fletcher, which ended with the prophetic sentence "that we can find safety and progress only in proportion as we bring into our methods of statecraft the guidance of biological truth"

It is time, however, to give some indication of the scope of this big book, and that is not difficult, for there is a progressive plan It begins, physiologically, with the living body, it surveys, morphologically, the forms or patterns of life, it insists that the key to intelligibility is the concept of evolution, it discusses the factors in individual development and in racial history (ontogeny and phylogeny), it sketches the ascent of life throughout the ages, the adventures and achievements of the ever-changing Proteus Then the book begins again, as it were, from the vantage ground it has gained, and envisages the pageant and drama of life—a fine introduction to ecology But the drama has its tragic side and this leads to a consideration of disease and the present very chequered health of *Homo sapiens*, who so often belies his specific name But the activities, the ascent, the adventure, and the drama of life have all their subjective aspect, as real as the objective, though more elusive, and the eighth book of the treatise deals with behaviour, feeling, and thought, leading on to a tentative monistic theory (not so far from the ancient hylozoism !)—the conception of "a single universal world stuff with both material and mental aspects, of which, so far as we know, life is the crowning elaboration, and human thought, feeling, and willing the highest expression yet attained" The concluding 'Book' deals with the biology of man, and, with a bow to sociology, ends on a melioristic note—"Life under Control"

"The Science of Life" rather disarms criticism by its frankness and sincerity and by its freedom from dogma Thus, in discussing the trans scientific question of purpose in or behind evolution, the authors state (1) the view "of Bergson and Shaw" that organisms work out their own evolution purposively, if not even purposefully, and (2) "the Creationism-up to date" of some modernist theologians, that the world of life is the realisation of a divine purpose, which was dynamically embodied in the original institution of the order of Nature When the reader has got these post Paleyian views before him as clearly as may be, he is told that "The Science of Life" must say "No" to the first theory, and cannot say "Yes" or 'No" to the second Personally, we are not inclined to be bluffed by a too abstract science, as if it were the only pathway towards truth, but we must admit that the authors occupy a clear headed and reasonable position—that biology, as biology, has no pronouncement to make on the

validity of the philosophical or religious concept of a purpose behind evolution

Though the book runs to nearly 900 pages, that is not much for an appreciation of the whole gamut of life So we are not inclined to say that there should have been more about enzymes and less about the humorous "Margery" and the teleplasm she produces from her mouth We are sure that the authors must have thought out very carefully what seemed to them the best utilisation of the available space, and their restraint, relaxed just a little perhaps for "Margery", is admirable

In reading this remarkably successful presentation of the essentials of biology, our pleasure has been occasionally interrupted by finding a crumpled roseleaf, but it is in no carping mood that we give just a few illustrations "The Science of Life" is certainly not an apsychic biology, yet why does it insist that the body is a machine, and elaborate a comparison which has eventually to be withdrawn as inadequate? Similarly with the use of the word 'mechanism' for the nervous system and the like The authors are all right, but will their readers be? If biologists say 'machine' often enough, people will begin to believe that they mean what they say In this particular case, we think that would be a pity, for we agree with the authors that an organism is more than mechanism

A larger crumpled roseleaf is the picture of random variations and blind selection No doubt there are saving clauses and corrective illustrations, but some readers will be apt to relapse to the old nightmare view of evolution as a chapter of accidents, which it certainly is not For many variations are orthogenic, and many are obviously congruent with the already established organic architecture and metabolic routine Many express themselves in accordance with laws of growth and conditions of organic stability How many plant variations in the present (and presumably in the irrecoverable past) are shortenings or elongations of the vegetative or floral axis! Similarly, many animal variations are shortenings-down or lengthenings-out of particular arcs on the general life-curve or trajectory And so on at great length, for the authors know well that a very strong case can be made out for the frequency of definiteness in variation

Then as to natural selection, it is inadequately summed up in such words as "automatic" and "blind" How often the organism tries to play its hand of hereditary cards, endeavouring after well-being It is often automatically selected, but it often deliberately selects Many an able-minded bird or mammal is a factor in its own evolution, though it has no prevision of more than an immediate goal Again, the general reader requires to be told that the everyday natural selection of nuance variations, though in a sense "blind", is a sifting in relation to an already established *systema Naturæ* of intricate and stabilised inter relations

Then again, while we agree with a useful passage on the seamy side of evolution, which certainly includes, as Ray Lankester so well insisted, its degenerations and retrogressions as well as its advances and achievements, we cannot agree with the statement that "we find throughout the rest of life parallels to the diseases that haunt our own" On the contrary, we are prepared to defend the thesis that wild Nature (that is, apart from man's interference) is characteristically marked by exuberant positive health, while in civilised society diseases are rife and sub health is becoming almost normal!

But enough of these minor criticisms, for we welcome the book with heartiness It is an achievement of popular exposition in the best sense (and many professional biologists would do well to read it), it is written with learning and lucidity, and permeated with the idea of evolution, including a human evolution which will continue the more rapidly the more it is inspired by the science of life

Our Bookshelf

Reports of the Progress of Chemistry Issued by the Society of Chemical Industry Vol 15, 1930 Pp 758 (London Society of Chemical Industry, 1931) 7s 6d to members, 12s 6d to others

COMMONPLACE as the phrase has become, of this series of reports it may, and indeed should, be said that no chemical library ought to be without it The flood of literature which descends upon students and practitioners of chemistry grows ever greater, and a correspondingly warmer welcome is given to authoritative surveys The annual report on the progress of applied chemistry during 1930 is invested with added value in respect of its early publication, for it has been made available six weeks earlier than the corresponding date of publication last year

Applied chemistry is surveyed in twenty-five chapters The following are by the same contributors as for 1929 General, plant, and machinery (R Edgeworth Johnstone), mineral oils (A E Dunstan), fibres, textiles, cellulose, and paper (J C Withers), iron and steel (C O Bannister), non ferrous metals (A R Powell), electro chemical and electro-metallurgical industries (H T S. Britton and [1930] R A Robinson), soils and fertilisers (E M Crowther), sugars, starches, and gums (L Eynon and J H Lane), fermentation

industries (H L Hind and F E Day), foods (L H Lampitt), fine chemicals and medicinal substances (E Stedman) Other sections are fuel (H J Hodsman and A Kay), gas, carbonisation, tar, and tar products (J Macleod and T A Wilson), colouring matters and dyes (L J Hooley), bleaching, dyeing printing, and finishing (A J Hall), acids, alkalis, and salts (P Parrish and F C Snelling), glass (M Parkin), refractories, ceramics, and cements (J H Chesters and W J Rees), oils, fats, and waxes (H M Langton), paints, pigments, varnishes, and resins (G C Attfield, J O Cutter, L R Hickson, and H Causer), rubber (T L Garner), leather and glue (R H Marriott and H Phillips), sanitation and water purification (A Parker), photographic materials and processes (A Batley and E E Jelley), explosives (J Weir) Consideration of essential oils is deferred until next year

There is much information of interest to the general scientific reader, for example, it is recorded that the price of platinum is now below that ruling in 1914, that the extraction of rhenium, rarest of metals, is being operated commercially in Germany, and that the 'talkies' have stimulated research on photographic emulsions The chapter on sanitation and water purification deserves special commendation, for although the general standard of the reports is high, some tend more than others to become an expanded list of references It could be wished, too, that every reporter would survey work which, although of obvious industrial importance, has been classified for purposes of abstract publication as 'pure' chemistry A A E

Von Zahlen und Figuren Proben mathematischen Denkens für Liebhaber der Mathematik Von Prof Hans Rademacher und Prof Otto Toeplitz Pp vi + 164 (Berlin Julius Springer, 1930) 9 60 gold marks

It has been rightly said that the high walls built up round mathematics by the signs of integration and summation, cause mathematics to be a permanent mystery for the average thinking person It is true that a thorough insight into higher mathematics requires special training, yet within these abstruse theories, there must be some parts and some examples, at least, which, properly explained, could enable non experts to peep through the complex texture of mathematics, and derive thereby some measure of enjoyment This is the spirit which underlies the little work under notice Although this book will teach nothing new to mathematicians, it will be found most interesting and helpful by those who are interested in mathematics Without using anything but logic and the most elementary notations, the authors are able to guide one through the mysteries of the prime numbers, of incommensurable lines and irrational numbers, the theory of aggregates and the paradoxes of transfinite numbers, the doctrines of the polyhedra and the measurement of the circle Although their exposition is based on mathematical facts, the authors lay more stress on the general form and method of the questions treated, while occasional historical remarks add to their interest Thus, instead of showing the pragmatical aspects of mathematics, or their philosophical importance, the book emphasises the internal and structural characteristics of pure mathematics The student of logic, in particular, will find in this very able book an ample field for his speculations T G

Synthèses et catalyses industrielles fabrications minérales Par Prof Paul Pascal Deuxième édition Pp vi + 456 (Paris Hermann et Cie, 1930) 70 francs

Prof Pascal's book is divided approximately into two parts, the first dealing with nitrogen compounds and the utilisation of atmospheric nitrogen and the second with sulphuric acid The treatment is detailed and the theory of the processes receives special attention, so that the book is particularly useful in supplementing the more technical treatises. A very brief treatment of hydrochloric acid is given, in which the modern synthetic process receives most attention The references to the literature are very incomplete, and many important special treatises which could be consulted, in amplification of the various sections, are not mentioned

Although the author begins with an account of the "Nitrogen Problem", this is somewhat out-of-date, since it does not make clear that the real nitrogen problem at the present day is an economic one There is now no possibility of a shortage of fixed nitrogen, the problem is how to sell it Every country is, or shortly will be, self-supporting, and, as the newer processes are installed, the competition with the older will become more and more acute The trouble will increase as time goes on and the economic difficulties of over-production, which were considered visionary during the War, will become more and more menacing

Some Dogmas of Religion By Dr John McTaggart Ellis McTaggart Pp lii + 299 (London Edward Arnold and Co, 1930) 6s net

Messrs Edward Arnold and Co have done a valuable service in issuing a new and cheaper edition of the late Dr Ellis McTaggart's famous book, with a delightful introduction by Dr C D Broad "Some Dogmas of Religion" has been long out of print (it was first published in 1906) and second-hand copies have been difficult to find and expensive to buy Of this work Dr Broad says "In many respects it is a model of popular philosophical writing It presupposes no knowledge of philosophy, it is written with admirable clarity, and abounds with apt and amusing illustrations, and it deals with problems which have interested almost all intelligent men in all ages" It was McTaggart who said that the man who has no religion cannot have a bad one, and it was he who expressed the hope that "a time may come when metaphysics may attain the same certainty in a higher sphere which is now often reached by science in a lower sphere" It is well known that McTaggart managed to combine atheism with a belief in immortality and the Church of England. But he was what has become more rare nowadays; he was a serious thinker

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*]

Formation of Methyl Alcohol by the Direct Oxidation of Methane

THE isolation and identification of the primary oxidation product of a hydrocarbon is so crucially important from the point of view of the theory of hydrocarbon combustion that no effort has been spared to overcome the experimental difficulties involved For, although there is considerable agreement that the main course of the oxidation proceeds in accordance with the hydroxylation theory, during recent years there has been some controversy as to whether the *initial* product is an hydroxylated molecule or a peroxide

Hitherto the cumulative weight of evidence, both direct and indirect, has been much more in favour of the initial formation of an hydroxylated molecule rather than that of a peroxide Thus the initial formation of ethyl alcohol by the interaction of ethane and ozonised oxygen at 100° C, the results of recent studies of the slow oxidation of ethane, the formation of acetaldehyde (by intramolecular change from vinyl alcohol) during the initial stages of the slow combustion of ethylene, and what is known concerning the explosive combustion of methane at high initial pressures, have all pointed unmistakably in that direction Nevertheless, until recently, all efforts to isolate the corresponding alcohol from the initial products of the slow interaction of one of the simpler paraffins with oxygen have been frustrated, apparently because under ordinary conditions the further oxidation of such an alcohol to the di-hydroxy stage occurs so rapidly Hence upholders of the hydroxylation theory have always postulated an initial 'non stop run' through the mono hydroxy to the di-hydroxy stage

Since the publication, in November last, of the results of a reinvestigation by Mr S G Hill and myself of the slow combustion of ethane (*Proc Roy Soc*, A, **129**, p 434), which showed that the initial product was not a peroxide but either ethyl alcohol or some less oxygenated body, Dr D M Newitt and Mr A E Haffner have succeeded in obtaining substantial quantities of methyl alcohol by the direct interaction of oxygen and methane at temperatures of 360° and pressures of about 100 atmospheres Under such conditions, and using a mixture initially containing methane and oxygen in the ratio 9 1, interaction was complete in a few minutes, about 17 per cent of the methane burnt was recovered from the products as methyl alcohol, another 0 6 per cent as formaldehyde, and the remainder as oxides of carbon and steam No hydrogen was liberated, and not even a trace of peroxide formed The methyl alcohol formed was isolated and identified by converting it into both methyl salicylate ('oil of wintergreen') and methyl *p* nitro benzoate (m p 95°), and it was estimated as methyl nitrite A full account of these very important experiments will be published in due course by Dr Newitt and Mr Haffner, who are to be congratulated on having thus shown conclusively that the slow oxidation of methane proceeds throughout in accordance with the hydroxylation theory

WILLIAM A BONE
Imperial College of Science and Technology,
London, S W 7, Mar 21

Fine Structure in the Hydrogen Band Lines

WE have recently had an opportunity of examining the spectrum of H_2 in a large Hilger quartz spectrograph crossed by a reflection echelon The method, of which an account by one of us (W E W) is being prepared for publication elsewhere, gives a record of the structure of all the lines of fair intensity So far we have only had time to examine a small number of typical lines, but the results are very interesting The alternate strong lines of two typical bands which end on the $2p\,{}^3\Pi_{ab}$ levels are all found to be double with the weaker component on the long wave length side (No description of the bands ending on the $2p\,{}^3\Pi$ levels has yet been published, but an account of these band systems by Richardson and Davidson has been communicated to the Royal Society) For example, in the $0 \rightarrow 0$ band of $3d\,{}^3\Sigma \rightarrow 2p\,{}^3\Pi$ we find that the $Q1$ line 5931 368 is definitely double, the components having an intensity ratio of about 3 to 1 and a separation $\Delta\nu$ about 0 21 wave number $Q3 = 6002\ 816$ is an incompletely resolved doublet with $\Delta\nu$ about 0 17 $R2 = 5938\ 620$ is an unresolved doublet with $\Delta\nu$ about 0 11 $R4 = 5982\ 561$ is not a simple line, but it is too weak and hazy to estimate the separation In the $1 \rightarrow 1$ band of the same system $Q1 = 6021\ 273$ is a very clear doublet with intensity ratio about 5 to 3 and $\Delta\nu$ about 0 21 $R2 = 6027\ 977$ is an unresolved doublet with $\Delta\nu$ about 0 08

We can compare the foregoing with typical lines of the $0 \rightarrow 0$ band of the a system $3p\,{}^3\Pi_{ab} \rightarrow 2s\,{}^3\Sigma$ [1] $Q1$ and $R0$ appear to have a very close satellite on the *short* wave length side of the main line $Q2$, $Q3$, $R2$, $R3$ are fairly sharp lines, but not so sharp as some lines in the spectrum $R1$ is a doublet with the weaker component on the *short* wave length side, intensity ratio about 3 to 10, and $\Delta\nu$ about 0 22 Unless this $R1$ is a blend with an unclassified line, these results mean that $3p\,{}^3\Pi_b$ is complex with the stronger level lower (as in $2p\,{}^3\Pi_{ab}$) and so is $2s\,{}^3\Sigma$ but with the weaker level lower The comparative magnitudes of the triplets (which we have only resolved into doublets run $2p\,{}^3\Pi_{ab} > 3p\,{}^3\Pi_b \approx 2s\,{}^3\Sigma > 3p\,{}^3\Pi_a$ If $R1$ is a blend the width of $2p\,{}^3\Pi$ is much greater than that of the other levels, but the remaining conclusions would require reconsideration

On the other hand, typical lines of the singlet systems such as 4856 553 ($= 0 \rightarrow 1\ P5$ of $3d\,{}^1\Pi_a \rightarrow 2p\,{}^1\Sigma$) 4873 010 ($= 0 \rightarrow 1\ Q3$ of $3d\,{}^1\Pi_b \rightarrow 2p\,{}^1\Sigma$), and 4822 94 ($= 2 \rightarrow 4\ R3$ of $3d\,{}^1\Sigma \rightarrow 2p\,{}^1\Sigma$) are sharp lines with no evidence of structure beyond temperature breadth and are definitely sharper than any of the lines so far considered This is not due to some accidental circumstance connected with the different region of the spectrum in which they lie For example, 4849 303, which is $0 \rightarrow 0\ R1$ of 4 (or 3)$p\,{}^3\Sigma \rightarrow 2s\,{}^3\Sigma$, and lies near these lines, is complex and asymmetric with the bulk of the energy not in the centre 4838 242, which is $R3$ of the same band, is similar to the $R1$ line except that it is weaker

The measurements given above are of a preliminary character We have a plate which looks better than the one on which they were made and we hope to improve on them The limit of our resolution is set by the natural temperature width of the lines, it is nowhere near the limit of the instruments employed We cooled our discharge tube in liquid air No doubt better results could be got with liquid hydrogen, but this is not available

These observations firmly establish the correlation between the spectrum of molecular hydrogen and that of atomic helium

O W RICHARDSON
W E WILLIAMS
King's College, Strand, W C 2, Mar 12

[1] Richardson and Das, *Proc Roy Soc*, A, vol 122, p 688, 1929

The Meaning of Existence

WHAT Sir James Jeans says (NATURE, Feb 28, p 304) is, of course, quite true, but it scarcely answers Prof Muirhead's question May I try to explain what existence means in physics?

Primarily, it means the truth of some law having the form which defines a substance or object To say that silver exists is simply to declare that it is possible to demonstrate experimentally the association of the 'properties of silver' a certain density, melting point, and so on No serious person during the last fifty years has believed that the ether exists in this sense

Secondarily it means the truth of some theory A theory is not true unless (*a*) true laws can be deduced from it and (*b*) its hypothesis is intrinsically plausible This intrinsic plausibility is often derived from analogy with laws, if the laws from which it is derived are of the aforesaid form, the theory implies the existence of something Kelvin held that the ether exists because he believed in a theory the hypothesis of which had an intrinsic plausibility arising from an analogy with the laws describing the oscillations of a continuous medium That theory is now known to be false on ground (*a*), Kelvin's ether, therefore, does not exist But another theory has been put forward the hypothesis of which is a set of equations having an imperfect analogy with those describing the geometrical laws of space—which might be occupied by a continuous medium This theory is certainly true on ground (*a*) Some of us (including Sir James Jeans, I think) do not feel that the theory derives any intrinsic plausibility from this loose and indirect connexion with a continuous medium, we therefore reject the existence of the ether on ground (*b*) Others feel that it does, the idea of a continuous medium filling all space helps them to understand and believe relativity, for them both (*a*) and (*b*) are satisfied, and they hold that the ether exists Since the difference is one of personal taste (not as Eddington suggests, of words), there is no way of deciding between us

Two comments may be added (1) Physicists do not apply these criteria of existence consciously, they can be brought to light only by examining what physicists do believe to exist That is inevitable, for physics does not arrive at truth by formal reasoning based on fixed principles, it employs reasoning only to expound and to co ordinate conclusions reached by some more instinctive process (2) Existence in the physical sense has, of course, no meaning outside the region of experience that can be analysed into laws, and it is hopeless to explain what physical existence means to anyone to whom a law is not a primary and unanalysable conception NORMAN R CAMPBELL

155 Hagden Lane,
Watford Herts, Mar 1

I HAVE to thank Sir James Jeans for his courteous reception (NATURE, Feb 28, p 304) of my recent communication in these columns I had no intention of starting metaphysical hares in this field, but merely to express my agreement with him in holding that physical discussions are also apt to have their hares unless we begin with definitions of our terms His very interesting letter brings this home from the side of the contrast between the physicist of forty years ago with his assumption of "a vast independent universe of concrete machinery, unthinkingly and unconsciously accepted as his universe of discourse", and the scientific worker of to day, who finds his universe of discourse in "a phenomenal universe as apprehended by his brain" Though I should perhaps use other terms for the latter, I think that this well describes the change in the intellectual atmosphere brought about by recent developments in physics, to which I began by alluding in my former letter The "vast independent universe of concrete machinery" had not only established itself in the mind of the physicist of those days as independent, but also it was endangering the independence of all other universes by reducing them to appanages of itself, as the only reality, containing the "promise and potency" of all other forms of existence

Since then, not only have other universes (for example, those of mind and its creations in art, law and morality, science itself, to mention no others) staked out claims of their own in a lateral direction, but also physics itself, in extending its work vertically, has struck on a world to which the old conception of "concrete machinery" seems to be no longer applicable and the method of behaviour of which has to be expressed in quite other terms How this world is to be co ordinated with that of concrete machinery is, I suppose, one of the questions that at present occupy and are likely long to occupy the foremost scientific workers

What Sir James Jeans, among others, as I understand him, has suggested, is the paradoxical conclusion that, in thus deepening the view of its own universe, physics has revealed analogies between it and other universes that *prima facie* belong to an altogether different order, and has thus opened up the possibility of a synthesis founded, not on their subordination to mechanical conceptions, but on the free right of each to develop its own underlying assumptions in a republic of inter related universes

If there is any truth in this view, we may thank discussions like that out of which this correspondence rose for bringing it more clearly to light Its precise bearing on the particular point at issue is another matter My own amateurish suggestion was not exactly that which Sir James Jeans attributes to me I mentioned the world of values as a conspicuous example of a universe of discourse beyond the field of "pointer readings", but "values" have enough to answer for without being loaded with the problem of ether Ether might be shown to serve a purpose, to have, if we like explanatory value, and that, I suppose, is what its advocates try to show, but on that I am not competent to express an opinion

If I may restate it in other terms, perhaps less ambiguous than those I used, what I meant to suggest was, *first*, that whatever can be said for the existence of such an entity, it seems to be becoming more and more obvious that it does not fall within the universe defined as "that which is continuous with the felt, waking body", and *secondly*, that the insistence upon it nevertheless as a real entity may not be unconnected with what Meyerson calls the "natural metaphysic" of the human mind which prompts it to seek for substantiality in what it takes as "given" For, in spite of what writers like Whitehead are saying in criticism of the old category of substance, we may drive it out with a fork but it will always recur, and if there is no place for it in the universe of mathematical physics, there will always be those who will try to find one elsewhere

J H MUIRHEAD

The Use of Covers on Lambs in Biological Work on Wool

MY fellow workers on wool in the northern hemisphere will soon be welcoming a crop of lambs I should like to tell them of the usefulness of the simple device of light covers Covers for older sheep have already proved most valuable in work on the chemistry of yolk by my colleague, Mr W G Sutton The

covers provided for my lambs protect the tips of the long fibres, which otherwise have largely become broken at the age of four or five months For the classification of fibre types, it is necessary that the tips should remain intact The covers also retain the loose birthcoat kemp The kemps so far mainly studied are coarsely medullated fibres that complete their growth in a few weeks and are soon shed The coarser of these can be recognised at birth as destined to fall out, but fibres having the structural features of the finer kemps may persist, being thinner and less medullated below the point at which a shed fibre completes its growth The most satisfactory way to ascertain which fibres are shed is to hold them in the fleece by a cover By sampling at suitable times, it is then possible to compare the numbers and types of shed kemp with the numbers and types of fibres which there is reason to regard as succeeding them in the same follicles

The material that has been used is a brown proofed duck Sometimes a complete band of about eight inches has been fastened round the middle region of the sheep, sometimes only the upper half has been covered, the band being held in position by elastic bands under the belly In many cases this small cover has been protected by a larger one like a horse cover The lambs were first covered when about two months old adjustments having been made as required Up to the present time, three months after covering, the tips have been sufficiently preserved There is evidence that an extremely tight cover interferes with normal growth, but otherwise growth appears to be unaffected by covering In work on shorter kemps that have completed their growth at birth, it will be necessary to put covers on at birth

The study now in progress of the fibre types of the New Zealand Romney sheep and their development has reference especially, from the economic point of view, to the occurrence of medulla From the practical point of view, kemps are not the most important medullated fibres in this breed, but they are the first to begin to grow, and an understanding of their place in the fleece is fundamental

The work of Mr J A Fraser Roberts on kemp in the Welsh Mountain breed has been very much in mind in this investigation He has found that lambs with the same amount of birthcoat kemp may later have very different quantities of kemp The problem thus raised is also encountered in the New Zealand Romney I was much impressed by the statement, made in conversation several years ago, by Prof J E Duerden, that associated with birth there is a check upon the growth of a lamb's coat He was referring then to the form of his 'sickle fibres', with a medullated sickle shaped apical end, followed by a finger region, and he has suggested in a recent letter that the sub apical thinning found in the majority of the bigger birthcoat kemps in the New Zealand Romney may be 'birth-thinning', as he calls it This conception has come to be the guiding idea in the work now in hand In the light of this 'birth check', the structural differences displayed by the array of fibre types, that begin their growth at different times, fall simply into line Certain marked differences between individual animals in the array of fibre types are to be explained by differences in the intensity of the check at a series of corresponding stages of development Differences in the time of onset and/or in the maximum intensity of the birth check are affording a satisfying explanation of differences in the relative numbers of certain fibres, especially sickle-fibres, that are shed or continue growing I believe that an intense check causes fibres to persist that would be shed if the check were less severe In the search for the significance of various other features in the development of the coat, the principle of the birth check promises to be illuminating The birth check may well prove of interest, as an inhibiting effect, from the point of view of the physiology of heredity, but the need for an understanding of the respective parts played by genetic and non genetic factors will at once be apparent

A preliminary description of the fibre types of the New Zealand Romney hogget and their development appeared in the *Wool Record* of Oct 4, 1930 I am enjoying the benefit of discussion through the mail with the biologists that have been mentioned With the limitations inherent in work upon large, slow-breeding animals, it would be especially helpful to be in communication with any workers interested in related problems in other parts of the world It is clear that there are radical differences, apart from fibre diameter, between the South African Merino and the New Zealand Romney in the structure and development of the fibre types This fact is far from astonishing, but as the principle discovered by Prof Duerden in the Merino is proving so helpful in work on the coarser woolled breed, the importance of comparative studies is emphasised

F W DRY

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New Zealand, Jan 24

Virulency of *Tilletia caries* on Wheat Varieties

IN a letter in NATURE of Feb 16, 1929, vol 123, p 243 I stated that certain wheat varieties thought to be resistant to bunt were susceptible when they were contaminated with the bunt spores that had been produced on those varieties It was inferred that, in the same way that the plant breeder could select a unit from a population of a variety for resistance to a certain pathogen, so the mycologist might select a pathogen from an analogous population to which the given host was susceptible

In the course of the past seven years, I have found no wheat variety that is consistently immune or very markedly resistant to this disease In the majority of the varieties studied, it was sufficient to contaminate them with their own bunt, they were then susceptible if not, they were found to be susceptible to bunt spores from other varieties—this bunt originating, so far as is known, from one source, namely, bunt that had been obtained on Little Joss wheat in 1923 For example, Hussar wheat contaminated with Little Joss spores in the season 1927–28 produced only 0 3 per cent of bunted ears, but in the succeeding season these spores were used to contaminate this same variety, and the estimated bunt percentage was then 49 It is suggested here that when traces of bunt are observed on a so called resistant variety, this fact should not be ignored, as it has been in the past It is thought this trace of bunt is a significant indication that a particular physiological form in the population of the parasite has found the given host susceptible Perpetuation of that form on the particular variety may show it to be markedly susceptible

That physiological forms of this parasite exist is shown by the following example Martin wheat appears to be resistant in England to bunt produced on Little Joss wheat, since, during the past six years, bunted ears were observed twice only, the percentages 0 5 and 0 6 were recorded on those occasions When, however, a sample of this wheat from the Cambridge plots was grown in Denmark and contaminated with indigenous bunt spores from a local

Danish variety, it produced 27 per cent of bunt Martin wheat, when contaminated with bunt spores from White Odessa grown on the University Farm, Cambridge, produced 54 per cent of bunted ears, and this White Odessa bunt had grown previously on Little Joss wheat, and the spores originated, so far as is known, from the original inoculum obtained from Little Joss wheat in 1923 It is clear, therefore, that physiological forms exist, indeed, that this pathogen is analogous to the host which it parasitises, in that it is a population from which units may be obtained

It may well be, however, that there were present naturally, on the original seeds of these varieties that were sown in 1923, a few bunt spores other than those with which I contaminated them artificially—physiological forms which would flourish in one environment and not in another

Futhermore, in their study of *T caries* many workers have undertaken very comprehensive experiments in order to determine the relative susceptibilities of wheat varieties to this parasite So much so that collections of bunt—" botanical specimens of no commercial value "—have been forwarded from country to country that their virulent nature may be determined I suggest that this is an excellent method for the commercial propagation and perpetuation of this disease—but one scarcely to be recommended in the best interests of agriculture Although no varieties are universally immune, it may well be that certain varieties are moderately resistant to certain physiological forms in certain localities, and it is with these that the plant breeder and the practical farmer are concerned It will not aid the cause of either to risk introducing foreign physiological forms

It may seem that these two opinions are contradictory for in one it is stated that no resistant varieties have been encountered, whereas, on the other hand, the opinion is expressed that it is most unwise to permit the introduction of physiological forms from one country to another, since it is to the detriment of both farmer and plant breeder In certain environments, however, it may be possible to breed varieties resistant to indigenous physiological forms of this disease which would be susceptible to forms introduced from other countries

W A R DILLON WESTON

Dominion Rust Research Laboratory,
Winnipeg, Man, Feb 10

Plant Distribution

IN the course of work on the geography of the Angiosperms, I have been impressed by the absence of any satisfactory theoretical explanation of the more general features in the distribution of these plants It will, I think, be agreed that the present distribution of the Angiosperms has been brought about by the intermingling, at different times and in different degrees, of a number of floras which have developed at different times and in different parts of the world This being so, any general theoretical explanation must provide not only a means of actual plant-movement, and a motive force for it, but also a directional control of movement and a discriminating or sifting factor

The dissemination of dispersal units obviously furnishes the means of movement, and the contemporary topographical outline and relief is clearly potent in controlling its direction As to the motive force, it is generally believed to-day that plant migration has been and is caused by change in external conditions and particularly by climatic change That is to say, change in external conditions is considered to make dispersal effective in bringing about changes in species position There is little doubt that this belief is correct, but it cannot be looked upon as an explanation of the facts of plant geography unless there is added to it some explanation as to how external change can react so as to entail species movement

It is one of the most obvious facts of plant distribution that a species can develop and maintain itself satisfactorily only within certain definite climatic and edaphic conditions, that it has, indeed, a 'range of tolerance' to external conditions In view of this, it is possible to put forward the theory that 'range of tolerance' to external conditions—or, more shortly, 'tolerance'—is a specific character, subject to variation and change in the same ways and by the same means as morphological characters

If this theory is accepted, then external change, which is itself a movement of conditions, must result in species movement, because dispersal, which is *potentially* in all directions, will be *effective* only in those directions which will maintain the spatial correlation between the species and the conditions within its range of tolerance By the same theory, the necessary sifting effect among species will follow from the differential effect of one and the same external change upon species having different tolerances

This theory of tolerance is set out and discussed at length in a forthcoming paper

R D'O GOOD

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Hull, Feb 19

Sir Isaac Newton and the Greek Philosophers

A FEW years ago I suspected that justice was not given to the brilliant astronomical discoveries of the ancient Greeks, and this led me to copy, to collect, and to classify several thousands of their passages relating to the structure and polity of the universe A sound independent basis was thus established for checking the originality of the reformers of astronomy since the sixteenth century, and for rendering "unto Cæsar the things which are Cæsar's", in a very important period of the history of science

The book of Copernicus, who had closely studied the philosophers of antiquity in their own language, broke down badly under the crucial and unanswerable test of comparison, and his heliocentric system is known to have been adopted from the Greeks without a single word of acknowledgment

In the work of the great Kepler, I came across several theories that had already been propounded by the ancients, but that founder of modern astronomy was just and generous, and ever eager to applaud the discoveries of his predecessors, so far as he could be acquainted with their writings

The treatment of the philosophers of antiquity by Newton is comparable with that of Kepler, and he did not hesitate to attribute to the Pythagoreans and to Aristarchus the discovery of the true system of the world It is a well-known fact that, in the first century of our era, Plutarch conceived universal attraction, asserting, moreover, that gravity, counterbalanced by centrifugal force, prevents the moon from falling on the earth, like a stone in a sling. As Newton does not mention the philosopher of Chæronea, he evidently never saw the passages in which these ideas had been expressed He did not understand the Greek language, and, like all great creators in science, he read little Were he to have been acquainted with the scientific works of Plutarch, he would never have failed to do him justice, as he had done, for example, to Kepler for his famous laws, or to Boulliaud for the law of inverse squares

There can, therefore, be no doubt that Newton started his inquiry by reasoning quite independently and in almost the same manner as Plutarch His splendid genius was fully equal to the task of discovering anew those eternal truths that had dawned in the mind of the Greek philosopher But there is an enormous difference between the mere conception of a scientific truth and its demonstration, and it is precisely that wonderful power of demonstration, backed, as it was, by mathematical intuition of the highest order and by an unrivalled use of induction and deduction, that has placed Newton above the men of science of all time

E M ANTONIADI

Paris, Feb 22

After-glow and its Life in Discharge Tubes

DURING investigations with electrical discharges through various types of tubes, I have observed some peculiarities of the after glow which appear to be worth recording It is well known that the intensity and duration of the after glow depend on the material of which the tubes are made It is also believed that the duration of the after glow ranges from a few seconds to a few minutes

While working with silica tubes filled with gases at rather low pressures, I discovered quite a strong after glow which persisted for about three quarters of an hour An after glow of such a long duration appears to be very interesting, and this fact may throw some light on the proper understanding of the mechanism of the after glow phenomenon The tubes were excited by a small induction coil giving 400 volts for its output, and the discharge was passed for two minutes During this time the tube did not show any appreciable rise in temperature This phenomenon can be repeatedly observed any number of times The after glow in silica tubes is given not only by nitrogen and metallic vapours, as is believed by some experimenters, but also it appears to be associated with almost all gases, as well as metallic vapours The glow is greenish when the current is switched off, but it soon develops into a yellowish white cloud filling the whole of the discharge tube, the density of illumination in the capillary portion being distinctly much higher than in the remaining portion of the tube

The rate of decay of this glow is extremely slow, and its intensity appears to be largely controlled by the pressure of the gas—lower pressures, ranging between 0 01 mm and 0 4 mm of mercury, being very favourable to large intensity The flash phenomenon recently recorded in NATURE (Nov 8, p 725) by Braddick is also seen in the after glows of silica tubes, but instead of there being only a few flashes before the disappearance of the glow, as observed by Braddick, the glow in the present case shows the flickering of light for quite a long time, giving an appearance something like the scintillations observed in a spinthariscope

Details of the above observations will be published elsewhere

D B DEODHAR

Physics Department,
University of Lucknow,
Feb 5

Colours of Inorganic Salts

IN continuation of the letter published in NATURE, vol. 125, p 163, Feb 1, 1930, we wish to report that absorption spectra of vapours of chromic chloride and ferrous chloride were taken at temperatures of 1000° C to 1400° C in the vacuum furnace in order to test the theory postulated in the above communication These substances were chosen because, according to information available in standard chemical literature, they do not dissociate within the temperature range mentioned and still yield sufficient vapour for absorption work

It was found that chromic chloride yields a number of absorption bands at λ4100 A and ferrous chloride at λ4350 A These bands we ascribe to Cr^{+++} and Fe^{++}, and they are due to magnetic transitions in the d^3 and d^6 shells of these elements In addition, we obtain continuous absorption, beginning from λ3000 A and extending to the limit of our apparatus, namely, to λ2200 A We ascribe this continuous absorption to the Cl^- ion

This later conclusion is sharply at variance with the interpretation put by Franck and his students on the absorption spectra of vapours of saturated chlorides of monovalent elements like sodium and potassium, etc They observed that with these vapours absorption begins near λ2900 A, and interpreted this as indicating the photo dissociation of sodium chloride into neutral Na and neutral Cl, that is, $h\nu_a$ equals heat of dissociation of NaCl molecule, which was obtained from consideration of a Born cycle, ν_a being the frequency at which absorption begins But vapours of almost all chlorides show absorption near λ3000 A (it is not possible to locate this point with any degree of precision within 200 A units), including the vapours of magnesium, aluminium, and silicon chlorides, which show no banded absorption, and by chromic chloride vapour and ferrous chloride vapour, which show band absorption In these cases, the energy relations (correlation between $h\nu_a$ and heat of dissociation) as obtained from consideration of a Born cycle fail entirely We are therefore led to the conclusion that the continuous absorption is due to the vibration of the electron in the Cl^- ion, but whether it leads to dissociation of a kind postulated by Franck cannot yet be answered definitely

M N SAHA
S C DEB

Department of Physics,
University of Allahabad,
Feb 12

Transplantation of Portuguese Oysters into South African Waters

IT is now well known that the accidental loss of a cargo of Portuguese oysters (*O angulata*) in the Bay of Arcachon in 1866 resulted in this oyster establishing itself in the locality in a new environment Arcachon now produces hundreds of millions of *O angulata* annually The possibility of successful transplantation of this species is therefore proved If an accidental transplantation can be successful, it would appear that deliberate transplantation may be equally successful provided a careful selection of the ground be made

During a recent review of the distribution of oysters,[1] it was noted that oyster production on the South African coast appears to be infinitesimal in comparison with the apparent potentialities The hydrographical conditions of the south east coast of Natal would seem to be eminently suitable for the spawning and growth of the Portuguese oyster, a form which is absent from this region It is suggested therefore, that an experiment in the transplantation of this species might be as beneficial to South Africa as an unpremeditated one has been to France *O angulata* occurs on the north west coast of Africa and possibly more southerly, its absence from South Africa may be due to the set of the relatively cold Benguela or Antarctic current on the south-westerly shores[2] The Portuguese oyster

requires relatively warm conditions (68° F or more) for spawning and good growth, thus it is not unlikely that the general conditions intervening between the north west and the south of Africa have acted as a natural barrier to the spread of this species of oyster in a southerly direction

It is not improbable, therefore, that the artificial transplantation of the Portuguese oyster into South African waters might add a valuable economic product to that region

Whether private individuals would undertake an experimental venture of this kind is somewhat doubtful, and the Union Government would probably have to finance the experiment, at least in its early stages, if after due consideration the undertaking were considered economically promising It is possible that transplantation might be successful, but the experiment an economic failure, unless the economic factors are carefully borne in mind J H Orton

The University, Liverpool

[1] Nature, 123, p 451, Mar 23, 1929
[2] J M Marchand Report No 7, Fish and Mar Biol Survey, Union of South Africa June 1929

Deep Focus Earthquakes

In a report, issued by the Air Ministry and included in Nature of Feb 28 (p 320), of an earthquake which was registered at Kew Observatory on Feb 20, it was stated that the shock originated from a focus about 250 miles below the normal depth It may be of interest to explain how it was possible to obtain this information from the records of a single station

The first indication of deep focus was obtained from the comparatively feeble development of the surface waves H Jeffreys and others have pointed out that on theoretical grounds the amplitudes of surface waves should fall off very rapidly with increasing focal depth For normal earthquakes the ratio of the maximum amplitude (as it appears on a Galitzin seismogram) of the surface waves to the amplitudes of the preliminary impulses is about 10 or 20 For the disturbance in question, the ratio is only about unity It is difficult to recognise any well defined maxima on the records

The second indication is based on the results of an investigation which I have just completed and of which a detailed account will be published shortly This research has shown that for earthquakes of deep origin, additional phases may be produced by reflection at points near the epicentre To distinguish these waves from the ordinary reflected waves, PP, SS, etc, I have called them pP, sP, sS, etc The times of transit have been calculated for various depths of focus Some of these supplementary phases were recognised on the Kew records of the shock on Feb 20 and confirmed the belief that the focus was abnormally deep The estimate of the depth was obtained from the time intervals, which are as follows (P was recorded at 5 h 44 m 22 s G M T)

	Observed M	Observed S	Calculated M	Calculated S
$pP-P$	1	19	1	24
$sP-P$	2	2	2	4
$S-P$	9	19	9	20
$sP-P$	11	47	11	48

The calculated times are those corresponding to an epicentral distance of 77 5° (5370 miles) and a depth of focus of 0 06 of the earth's radius (that is, 250 miles), greater than normal

F J Scrase

Kew Observatory,
Richmond, Surrey,
Mar 2

The Audibility and Lowermost Altitude of the Aurora Polaris

From his very interesting account of the various observations on the aurora borealis, Prof S Chapman[1] concludes that doubt still exists regarding the audibility and low altitude of some auroræ

On Aug 10, 1928, I was at Fort Smith on Slave River in the Canadian north west (lat 60° N), and witnessed a remarkable auroral display in the evening, about 11 P M In my notes at the time, it was likened to waving curtains illuminated by a slowly moving searchlight The day had been uncomfortably warm and the aurora was a surprise, as I had always connected it with low temperatures It was also quite different from the auroræ I had seen in Nova Scotia many years before

In the constantly changing tints of this aurora, green and, to a less extent, yellow were the most conspicuous colours Time after time these coloured streamers moved slowly across the sky, frequently almost horizontally, each one gradually slackening speed until it came to rest, and its movement was clearly accompanied by a low hissing or swishing sound like that of gas escaping from a tap under pressure The sound, too, gradually died down with slackening speed of the streamer Several of us watched this display for more than an hour We were on the deck of a small steamer at the riverside, from which the bank sloped steeply upwards for some hundreds of feet This afforded some basis for estimating the height of the aurora, and it seems certain that it could not have been greater than a fraction of a mile The fact that there was no perceptible lag between sight and sound, shows that the distance could not have been great

Finally, this aurora was in striking contrast with others which I had witnessed as a youth in Nova Scotia in winter These 'northern lights', as I remember them consisted mainly at least of white light, and were often like the streamers from searchlights projecting upwards into the sky They were sometimes accompanied by low crackling sounds, and gave the impression of being far away to the northward Thus it appears clear that there are two quite distinct types of aurora R Ruggles Gates

King's College, London,
Mar 9

[1] Nature, Mar 7 1931 p 341

Faraday Relics

The Institution of Electrical Engineers and the Royal Institution are combining to commemorate, in September next, the centenary of Faraday's discovery of electromagnetic induction, and in connexion with the celebrations an exhibition is being arranged at the Albert Hall

The Royal Institution is contributing to this exhibition Faraday's original apparatus and illustrations of his experiments In addition, it is hoped to arrange at the Royal Institution itself a smaller exhibition of relics of a more personal character

The Managers of the Royal Institution would be glad to hear of personal relics, apparatus, and manuscripts of Faraday and those who possess any such objects and are willing to lend them for exhibition are asked to communicate with the General Secretary, Royal Institution, 21 Albemarle Street, W 1

W H Bragg
(Director)

The Royal Institution,
21 Albemarle Street, London, W 1,
Mar 18

Oceanographical Expedition of the *Dana*, 1928–1930 *

By Prof JOHANNES SCHMIDT, Ph D , D Sc ,
Carlsberg Laboratory, Copenhagen, Leader of the Expedition

THE DISTRIBUTION OF *NESSORHAMPHUS*, A NEW GENUS OF OCEANIC EELS

AS a biological example I may refer here to a new genus of pelagic eel which I am describing elsewhere under the name of *Nessorhamphus* [1] It is readily distinguished from other eels by the spatulate snout—so that seen from above it reminds one somewhat of the elongated beak of a duck—and the hind margin of the caudal fin, which is not rounded (Fig 4)

For several years I have known *Nessorhamphus* from the Sargasso Sea of the North Atlantic, our collections containing all stages from the egg and tiny larva up to adult specimens The larvæ are specially numerous, they occur in thousands and are thus well suited to the determination of the distribution, especially the breeding areas

During the *Dana's* voyage round the world we discovered that *Nessorhamphus* also occurs in the other oceans, in the Pacific as well as in the Indian Ocean, and the details of its distribution seem to me of so much interest that I propose to discuss them briefly here, even though the collections are not yet fully worked out In the western part of the Indian Ocean, around Madagascar, we found both larvæ and adolescent specimens of *Nessorhamphus* Closer examination showed that they stood so near *N ingolfianus* of the Sargasso Sea that they must be referred to this species, at the most, it can only be a matter of subspecific difference Comparison of the following averages of several important numerical characters in 200 larvæ from the North Atlantic and 70 from the Madagascar region proves this

Nessorhamphus ingolfianus	Total No of Myomeres	Preanal No of Myomeres	Postanal No of Myomeres	Large Blood vessel on Myomere No
North Atlantic	154 05	120 28	33 79	75 3
Indian Ocean around Madagascar	153 91	120 69	33 06	75 6

On the other hand, to the west of Sumatra, in the neighbourhood of the equator, the *Dana* obtained two adolescent specimens (in addition to larvæ) of a *Nessorhamphus* which was seen at the first glance to be different from *N ingolfianus*, and which I am introducing into ichthyological literature here under the name of *Nessorhamphus Danæ*, nov sp

The most obvious character is a deep black, well marked streak extending along the middle line ventrally from the head to somewhat past the anus (Fig 4, *B*), this streak is wanting in *N ingolfianus* *N Danæ* also differs in other characters, thus, the snout is relatively shorter and the distance between front of dorsal fin and the vent relatively longer The numerical characters also show differences The number of vertebræ in one of the specimens from Sumatra was found to be 137 (corresponding to 138 myomeres in the larval stage), whereas in 100 larvæ from a station in the Sargasso Sea the myomere numbers varied from 150 to 159, and in 65 specimens from the Madagascar region from 149 to 158

In the Indian Ocean we found *Nessorhamphus Danæ* not only west of Sumatra but also on both sides of the equator farther west, in the waters between the Maldives and Seychelles, and in specimens from the equatorial parts of the Indian Ocean the number of myomeres varied between 135 and 145, thus showing a range of variation similar to that of *Nessorhamphus ingolfianus* in the Sargasso Sea and round Madagascar

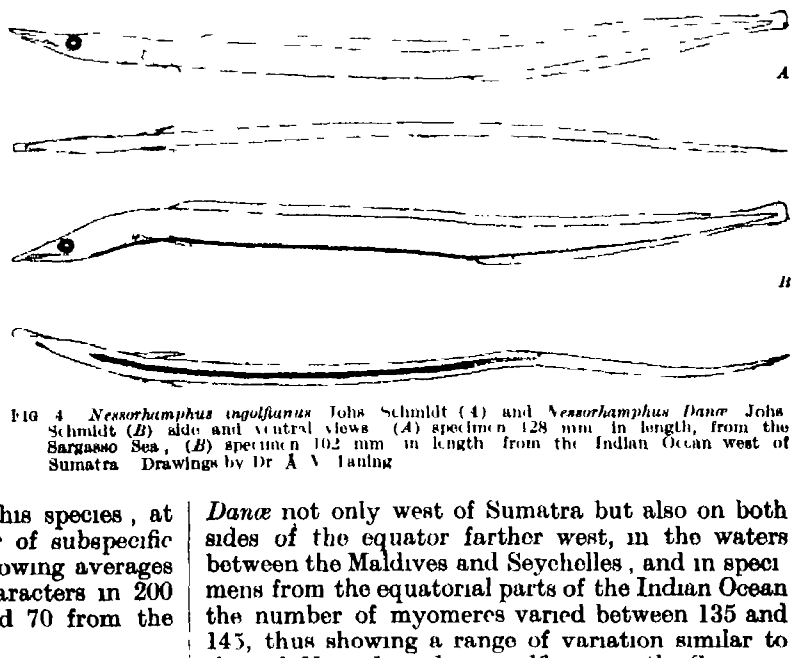

FIG 4 *Nessorhamphus ingolfianus* Johs Schmidt (*A*) and *Nessorhamphus Danæ* Johs Schmidt (*B*) side and ventral views (*A*) specimen 128 mm in length, from the Sargasso Sea, (*B*) specimen 102 mm in length from the Indian Ocean west of Sumatra Drawings by Dr Å V Tåning

In the Pacific we found *Nessorhamphus Danæ* in the equatorial belt north of New Guinea and Celebes, etc , the number of myomeres varying here between 136 and 145 † *Nessorhamphus* also proved to occur in the south Pacific along the whole stretch from the Marquesas to New Caledonia and the north-western part of the Tasman Sea, but this was not *N Danæ* It was a form which approaches *N ingolfianus*, both in its high number of vertebræ and the absence of the ventral streak which characterises *N Danæ* ‡

Turning now to the third ocean, the Atlantic, no specimens of *Nessorhamphus* were found by

* Continued from p 448.

† For twenty-seven specimens the averages corresponding to those given in the previous table were 140 37—112 19—28 10—72 04

‡ The number of myomeres varied in six specimens from 152 to 162, but in such a small number of specimens this is such a wide range that possibly a mixture of two forms is present

the *Dana* in the southern portion, from the Cape towards Ascension, but in the neighbourhood of the Line, on both sides of this, a few larval specimens were found which proved to belong to *Nessorhamphus Danæ*, with the number of myomeres varying from 135 to 145

The distribution of the genus *Nessorhamphus* is summarised in the accompanying chart, Fig 5 This is based on the occurrence of larvæ and thus represents the breeding regions As in all eel fishes, these are restricted to the warmer parts of the oceans For the rest, the most characteristic features of the distribution may be summed up as follows

1 Both main species, *Nessorhamphus Danæ* and graphical conditions also recall to some extent those of the Sargasso Sea I have not much doubt that *N ingolfianus* extends from Madagascar across towards Australia, and that *N Danæ* occurs from New Guinea far to the east in the equatorial belt

From our investigations of the home fishes we know what great importance the hydrography, and especially the temperature, has in the distribution of the different species, more especially at spawning time In 1909 I illustrated this in the case of the North Atlantic species of Gadoids, and demonstrated that it is the varying temperature requirements in the different species during the spawning period, when the species are specially sensitive, which determines the situation of the spawning

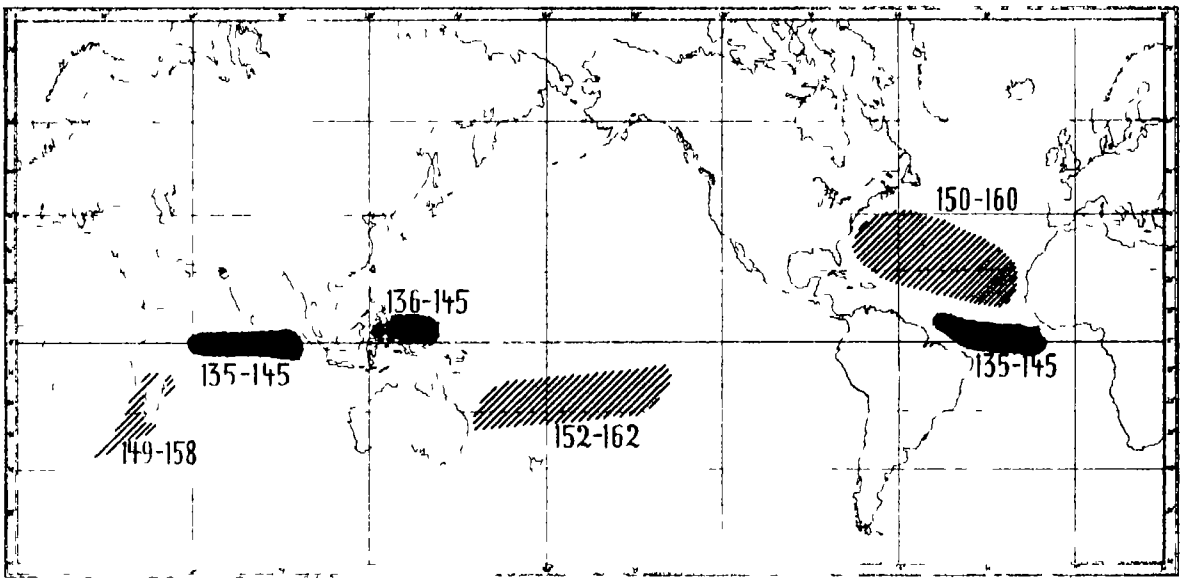

FIG 5 Distribution of the larvæ of *Nessorhamphus ingolfianus* Johs Schmidt shaded and of *Nessorhamphus Danæ*, Johs Schmidt black (each including subspecies or races) The figures denote number of myomeres

N ingolfianus (each including subspecies or races) occur and spawn in all three oceans

2 In each of the oceans the two species are distributed in the same manner, with regard to latitude, as in the other two oceans Thus, *Nessorhamphus Danæ* occurs in a belt about the equator, whereas *N ingolfianus* is found about the transitional circles, both on the northern and southern hemispheres We may call this type of distribution the latitudinal

This is the actual distribution of the genus *Nessorhamphus* so far as the *Dana's* investigations go Large regions of the oceans, however, in the North Pacific and South Atlantic for example, must be investigated before the picture is complete It would not be remarkable if it proved that the transitional region of the North Pacific contained a fish belonging to the form-series of *N ingolfianus*, or at any rate to a related species, for the hydrographical conditions there, at least in the western part, greatly resemble those of the Sargasso Sea One must similarly take into account the South Atlantic in the neighbourhood of the transitional circle, especially its western part, where the hydrographical grounds and thus right away the distribution of the different species [2] Also, there can be no doubt that in the case of the oceanic fishes it is also the hydrography—making allowances for the historic factors—which determines the breeding areas of the species and thus in the first case their distribution

Now, large and characteristic differences actually occur between the equatorial zones and the zones about the transitional circles in hydrographical characters, both in the upper and intermediate water layers, where the propagation and larval development of *Nessorhamphus* take place This applies to the temperature, salinity, oxygen contents, etc , and it cannot be doubted that such differences, in conjunction with specific demands on the environmental conditions, determine the spawning regions and distribution of the two *Nessorhamphus* species

The further examination of the *Dana* material will presumably bring to light types of distribution other than the latitudinal, as in *Nessorhamphus* , but this will undoubtedly be found again in many other cases, possibly with even greater clearness in other cosmopolitan genera of oceanic fishes,

especially in those which contain several main species, and, in contrast to the eel fishes, are not restricted to the warm zones but also occur and spawn in regions of lower temperatures

The above information regarding *Nessorhamphus* may be taken as a first example of what may be reached from two months' work, dealing with the *Dana* material from the point of view outlined in the beginning—that is, by using biometric methods and including the large larval material Without the latter, from the study alone of the quite few adult specimens available, we should not have understood in the least the peculiar features of the distribution of the genus Even if a great deal is still wanting, it is certainly not a common thing in natural history, along with the description of a new genus, to be able to give so much regarding the distribution of its species

OXYGEN IN THE TROPICAL PACIFIC

By HELGE THOMSEN, Hydrographer of the Expedition

On the 1921-22 expedition with the Royal Danish Research Ship *Dana* the remarkable fact was discovered, at several stations in and close to the Gulf of Panama, that the sea water contained practically no oxygen at a depth of *c* 400 m, but at that time there was no opportunity of following up the horizontal distribution of this phenomenon[3] As the projected course of the *Dana* in its world cruise in September 1928 lay across the Pacific from Panama to New Caledonia, one of the principal hydrographical aims of the expedition, as planned by its leader, was the investigation of the minimum distribution of oxygen towards the west

The result of these investigations, which were undertaken in the months of September, October, and November 1928, is displayed in Fig 6, which shows the oxygen distribution in a section from Panama to the south point of New Caledonia, the position being given on the route chart, Fig 2 The figures on the curves denote the percentage of oxygen observed, compared with the quantity of oxygen which would be found in the water if it were saturated with oxygen The smallest quantity was found in the Gulf of Panama at a depth of 400 m and amounted to 0 03 c c of oxygen per litre of sea water, corresponding to 0 5 per cent saturation This minimum extends westwards from the Gulf of Panama, always with nucleus about 400 500 m, but with steadily rising amount of oxygen As far as long 125° W the minimum value still remains less than 10 per cent, and up to *c* long 140° W less than 20 per cent, but about long 148° W, that is, near Tahiti, the minimum ceases to be apparent in the saturation percentage

Consideration of the section shows, further, that

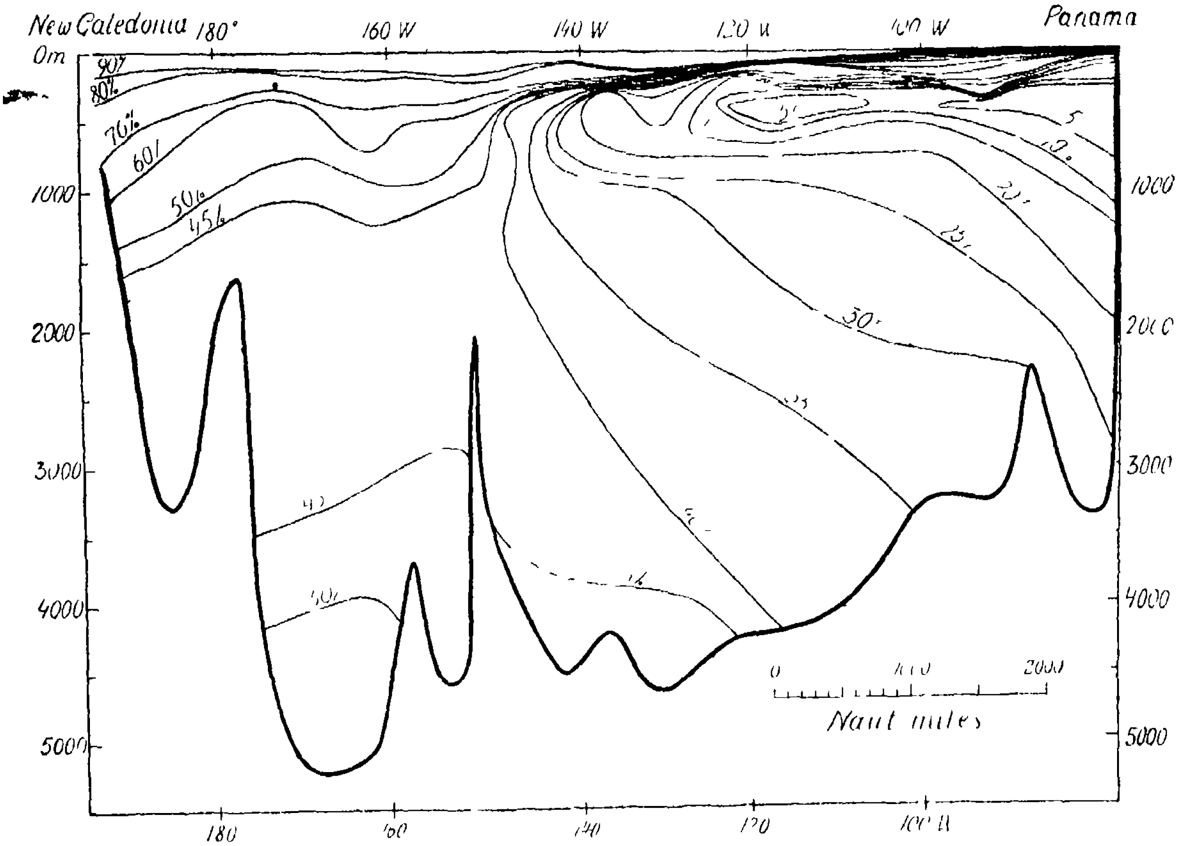

FIG 6—Section of the ocean from Panama to New Caledonia showing distribution of oxygen

it may be divided naturally into two portions with the boundary about Tahiti In the eastern portion the amount of oxygen diminishes very rapidly with the depth down to the minimum at 400 500 m , thereafter increasing again towards the bottom, where increasingly higher values are obtained the farther one goes westwards

On the other hand, in the western portion of the section we find a slower decrease in the amount of oxygen with the depth, until a minimum is reached at *c* 2000 2500 m , after which it again increases gradually towards the bottom This minimum, however, is not nearly so well marked as the minimum in the eastern portion, the saturation percentage not going below 40 per cent Thus, whilst the saturation percentage in the western portion is everywhere greater than 40 per cent, throughout the eastern portion it is less, with the exception of a surface layer of small extent and the bottom water in the part of the section which lies west of long 120° W

These conditions agree well with what one might have expected beforehand In tropical seas, with high temperature and relatively low salinity at the surface, the density of the surface water will be so much less than that of the layers below that the descent of oxygen to the latter by vertical convection currents cannot take place An addition of oxygen to the deeper layers in the equatorial zone must therefore come from meridional currents, which will be deflected westwards with the earth's rotation and thus come to have a stronger influence in the western than in the eastern portion of the ocean Hence the supply of oxygen will be greatest in the western portion, in agreement with the above section

It may be noted, however, that this section does not follow the same degree of latitude, extending as it does from lat 7° N in the eastern portion to lat 23½° S in the western portion If the indicated supply of oxygen to the equatorial zone takes place from the south, as the available hydrographical data suggest, this in itself would cause the western portion of the section to contain more oxygen than the eastern portion, and we should expect that a section due west from the Gulf of Panama would contain less oxygen than the foregoing Other observations indicate that this view is very probable For example, the American Carnegie Expedition, working in these waters a year after the *Dana* found an oxygen minimum of 0 5 to 1 per cent in depths between 100 m and 400 m at *c* lat 12° N and long 137° W [4] This minimum is of the same dimension as that found by the *Dana* expedition at Panama and considerably less than the minimum measured by the *Dana* on the same degree of longitude but some twenty degrees more to the south

In July 1929, when the *Dana* expedition was working in the waters north of New Guinea, an oxygen minimum of 27 3 per cent was found in 400 m at lat 3° 40′ N and long 137° 40′ E These observations afford strong support to the view that the layer poor in oxygen, which was first noticed by the *Dana* in 1922 in the Gulf of Panama, is centred about lat 5° to 10° N and extends at a depth of about 400 m right across the whole Pacific, though the minimum becomes less marked the farther we go westwards, yet still about 27 per cent in the westernmost part It is worth remarking that this oxygen minimum has about the same geographical distribution as the equatorial countercurrent The existence of the very poor oxygen layer under the latter shows that in these depths the currents with a meridional component must be extremely weak

In conclusion it may be mentioned that a somewhat similar oxygen distribution was found in the tropical part of the Atlantic in 1926 by the German *Meteor* Expedition,[5] and, though less strongly marked, in 1921 by the *Dana* along a section from Cape Verde Islands to Cayenne [6] Further, an intermediate oxygen minimum was found by the *Dana* in the tropical Indian Ocean during the Circumnavigation Expedition in 1929 There seems to be no doubt, therefore, than an intermediate oxygen minimum extends as a belt round the globe in the equatorial zone

[1] *Vidensk Med Dansk Nat For*, vol 90, p 371, Copenhagen, 1931

[2] See *inter alia* "The Distribution of the Pelagic Fry of the Gadoids in the North Atlantic from Iceland to Spain (*Conseil International pour l'Exploration de la mer*, vol 10, No 4, Copenhagen, 1909)

[3] Johs. Schmidt, On the Contents of Oxygen in the Ocean on both sides of Panama " (*Science*, June 5, 1925) *Idem*, Introduction to the Oceanographical Reports " The Danish *Dana* Expeditions, 1920–22, in the North Atlantic and the Gulf of Panama Copenhagen and London, 1929

[4] Department of Terrestrial Magnetism Carnegie Institution of Washington *Reports and Communications to Section of Oceanography* Washington D C, June 30, 1930

[5] H Wattenberg, Die Durchlüftung des Atlantischen Ozeans " (*Journal du Conseil International*, vol 4, No 1, Copenhagen, 1929)

[6] J P Jacobsen, Contribution to the Hydrography of the North Atlantic ' The Danish *Dana* Expeditions, 1920–22, in the North Atlantic and the Gulf of Panama No 3, Copenhagen and London, 1929 Johs Schmidt, "Introduction to the Oceanographical Reports ', *ibid*, No 1, Copenhagen and London, 1929

The Nature and Scope of Physical Science *

I

By Prof HERBERT DINGLE

SCIENCE may be defined as the recording, augmentation, and rational correlation of those elements of our experience which are actually or potentially common to all normal people The phrase cannot boast of elegance, but for clear thinking, rigidity and conciseness are the important considerations

To prevent excessive misunderstanding, some explanations are necessary, which limits of space compress to the barest minimum By 'experience' is meant everything of which we are conscious except rational conceptions Experiences 'common to all normal people' may for practical purposes be thought of as observations made by means of the senses, but since what fits them for scientific discussion is not the way in which we get them

* Substance of a course of four lectures delivered at the Royal Institution on Jan 22, 29 Feb 5 and 12

but the fact that they are universal, the more general description is preferable By expressing the data of science as experiences and not as the external world giving rise to them, we evade the problem of the objectivity of that world, that is a problem for philosophy, not for science Finally, the word ' potentially ' is inserted in the definition merely to include observations which might be made but are not, it is not a loophole for the admission of *hypothetical experiences* which *future* developments of the human organism might make possible

The definition limits science only in respect to its data and its purposes, it imposes no limitation on method As a historical fact, of course, science has almost invariably restricted itself to the familiar processes of observation and experiment for the accumulation of its data, and to abstraction and hypothesis for their rational correlation It is conceivable, however, that science might be advanced by other means, for example, clairvoyance, but if such means are employed, their indications must always be confirmed by common observation before they are accepted as a part of science

Nevertheless, in the history of science, the methods of abstraction and hypothesis have been of the utmost importance, and the significance of physics at the present day has, I think, been widely misunderstood through a misapprehension of their essential nature Let us look at them a little more closely

Abstraction is the detection of a common quality in the characteristics of a number of diverse observations, it is the method supremely exemplified in the work of Newton and Einstein Newton, for example, gave us ' laws of motion ' Now, motion is not an experience, what we observe are moving bodies Motion is an abstraction, a quality conceived to be possessed by all moving bodies, however much they may differ in size, shape, colour, beauty, virtue, or anything else The laws of motion express the characteristics of this common quality, and they are therefore a rational means of correlating a vast body of common experience

A hypothesis serves the same purpose, but in a different way It relates apparently diverse experiences, not by directly detecting a common quality in the experiences themselves, but by inventing a fictitious substance or process or idea, in terms of which the experiences can be expressed A hypothesis, in brief, correlates observations by adding something to them, while abstraction achieves the same end by subtracting something For example, to correlate the motion of Uranus with that of the other planets by abstraction in the year 1845 would have been a terrifying business The simpler plan was adopted of supposing the existence of another planet which, with Uranus, obeyed the laws of motion abstracted from the behaviour of the more familiar planets, and the problem was solved

A hypothesis of this kind can be " proved to be true " That is, of course, what occurred in the example just given, which led directly to the discovery of the planet Neptune But there are other hypotheses which cannot be thus verified, for example, the supposed birth of the planets through the influence of a passing star This is not the only, nor at the moment the most conspicuous, type of unverifiable hypothesis, but we shall return to this point later

The mental processes involved in abstraction and the formulation of hypotheses can be traced back through the ages At the beginning of modern physics, however, only the method of abstraction was employed Newton was the sworn foe of hypotheses The elements of his philosophy —mass, force, absolute space and time—were abstractions from observations, in terms of which the processes of the physical world were described He always strenuously opposed the imputation that he employed hypotheses, and although nowadays it is commonly stated that gravitation, for example, is a hypothesis, it could be shown, if space permitted, that it expresses nothing more than is actually contained in observation, that is, it is an abstraction The same method has now been applied to a more extensive field of observation by Einstein, and the theory of relativity is a pure abstraction after Newton's own heart The equations of the electro magnetic field, the principle of the conservation of energy, and the second law of thermodynamics are other examples of abstraction in physics

The great influence of Newton dominated the activities of physicists and mathematicians during the eighteenth century, and the progress of that time is summed up partly in the successful application of his principles to detailed phenomena and partly in the reformulation of his essential ideas into alternative expressions more convenient for certain calculations Hypotheses were at a discount But, fortunately for science, other influences were independently at work which, so far as physical science is concerned, found the most effective medium of operation in chemistry Chemistry, no less than physics, had throughout the Middle Ages been held back by the arbitrary adoption of ' principles ' and ' occult qualities ', but it had suffered no martyrdom such as had canonised physics and astronomy in the person of Galileo It had therefore no need of a formal body of doctrine, and while it could profit by the purifying influence of the great physicists, it could also regard with tolerance what to them was heresy Consequently we find chemistry freeing itself from superstition more gradually than physics, but at a smaller cost Thus, while Newton was declaiming against hypotheses, Stahl was conjuring up the spirit of phlogiston which was to direct chemical progress for the next hundred years This freedom of chemistry to be influenced, but not controlled, by the mathematical revolution is of the utmost importance, for by the gradual merging of the two sciences into one, physics has slowly become emancipated from the restrictions which Newton imposed, although whether she has done so without sacrificing the principles for the sake of which he imposed them is a matter of grave doubt

I have neither space nor knowledge to trace in detail the introduction of hypotheses into physics

To illustrate the process, however, here are three quotations from representative men of science, covering the period from Newton to the present time and separated by roughly equal intervals The first is from Newton himself (1687) "I frame no hypotheses For whatever is not deduc'd from the phænomena, is to be called an hypothesis, and hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy" The second is from Laplace (1796) "I will suggest an hypothesis which appears to me to result with a great degree of probability, from the preceding phenomena, which, however I present with that diffidence, which ought always to attach to whatever is not the result of observation and computation" The third is from Eddington (1926) "Care is taken to provide 'macroscopic' equations for the human scale of appreciation of phenomena as well as 'microscopic' equations for the microbe But there is a difference in the attitude of the physicist towards these results, for him the macroscopic equations—the large scale results—are just useful tools for scientific and practical progress, the microscopic view contains the real truth as to what is actually occurring" The direction of development is obvious, and its validity is the most vital question, both for the philosophy of science and for the application of scientific ideas to other departments of thought, at the present time

The introduction of the atomic hypothesis into physics raises the question of the significance to be ascribed to hypotheses which postulate entities (such as atoms and electrons) which are essentially unobservable I think the conclusion is inescapable that such entities can be regarded only as concepts, possessing no properties and subject to no laws other than those which are necessary and sufficient to enable them to correlate observations The question whether they are *real* or not is already answered in the designation of them, for we can scarcely regard anything as real, in the sense in which observed existences are real, which is essentially unobservable If we adopt such hypotheses, therefore, we have perfect freedom to shape them as we please, provided they achieve the end for which they were created We are not bound to give them the characteristics of phenomena They are employed for rational correlation and are not admissible to experience they must therefore have rational properties, but not necessarily sensible ones

This, however, was overlooked by the physicists of the early twentieth century, who appeared to be faced by an irresolvable dilemma in the inability of the atom to emit radiation without self-destruction The position was that either the solar system model of the atom, to which the development of the atomic hypothesis had apparently inevitably led, or the laws of electro-magnetism, abstracted from phenomena, had to be left out of consideration if the atomic hypothesis was to be extended to include the interaction of matter with radiation, and physicists in general were willing to abandon neither Why was this?

It was simply that they did not realise the essential character of a hypothesis The atoms, being hypothetical units, were in their hands to mould to the dictates of their imaginations, and they did not know their own freedom They thought of atoms, not as hypotheses but as potential phenomena and therefore necessarily subject to the laws already established for phenomena by the method of abstraction The process began when atoms were first introduced into physics At that time they were supplied instinctively with mass and the other Newtonian abstracted qualities, and the implication that they were potential phenomena took such hold of succeeding physicists that by the twentieth century its arbitrariness needed a genius to perceive it Fortunately the genius, in the person of Neils Bohr, was at hand Bohr retained the solar system model of the atom, but absolved it from obedience to the laws of electromagnetism

This step of Bohr's was the most significant in physical science since the introduction of the hypothesis of atoms What virtually it did was to establish the fact that the hypothetical atoms were pure conceptions that they belonged essentially to a different category from the facts of observation They were creatures of the imagination, to be formed into the image of our fancies and restricted by whatever laws we cared to prescribe, provided only that when they behaved in accordance with those laws they should reproduce phenomena They were removed from the realm of experience and deposited in that of reason

Developments have succeeded one another with almost alarming rapidity, but from the fundamental point of view nothing new has happened The solar system model has gone and a conception devoid of any pictorial aspect has taken its place, but that—if in so speaking we may disclaim any disrespect to the brilliant physicists who have organised the process—is but the ass's kick at the dead lion Whatever formal doctrine physicists may profess, they exhibit in practice no more belief in the phenomenal reality of atoms than in the philosopher's stone

News and Views.

The Duddell Medal for 1930 of the Physical Society was presented to Sir Ambrose Fleming at the annual general meeting of the Society on Mar 20 The medal is awarded not more frequently than once a year to persons who have contributed to the advancement of knowledge by the invention or design of scientific instruments or by the discovery of materials used in their construction Sir Ambrose Fleming's connexion with the Physical Society dates back to its very beginning, for he read the first paper at the inaugural meeting of the Society in March 1874 In 1879, Sir Ambrose designed a special form of resistance balance for comparing standard coils, and a special form of standard coil capable of taking up

more quickly the temperature of the water in which it was placed than the form before in use When practical incandescent electric lighting began, and quick and accurate workshop methods of electrical measurement became necessary, he made, in 1883, the first direct reading potentiometer set to read directly current and potential in amperes and volts by means of a standard Clark or Weston cell Sir Ambrose also designed a form of wattmeter, with which he made extensive researches on alternating current transformer efficiencies, reported to the Institution of Electrical Engineers in 1892 In this paper he first suggested the use of the term 'power factor', which at once came into everyday use

WHEN practical wireless telegraphy first began under Marconi in 1898, no appliances were obtainable for measuring wave lengths and frequencies In 1904, Sir Ambrose Fleming invented his cymometer, which provided a simple instrument for this purpose, capable also of measuring decrements and small capacities and inductances, and, in conjunction with Prof Clinton, he also devised a rotating commutator for measuring the capacity of aerial waves and Leyden jars used in wireless In 1904, he invented his now famous two electrode thermionic valve, which prepared the way for the subsequent improvement of the three electrode valve which is now the master weapon of the radio engineer Between 1892 and 1895 he carried out, in conjunction with the late Sir James Dewar, extensive researches on the electric and magnetic properties of matter at low temperatures, and devised for this purpose special forms of resistance coil, condenser, and bridge and potentiometer for the measurement of resistances, inductive capacities, and thermo-electromotive force He was the first to establish a laboratory for high frequency and radio measurements, at University College, London, where he was professor of electrical engineering for forty two years

THE British Science Guild has submitted to the Royal Commission on the Civil Service a memorandum upon the structure and organisation of the Civil Service, dealing with what it describes as a "national imperfection" The Guild points out that in many present day problems confronting Government Departments the technical and scientific aspects are of paramount importance, and it is therefore essential that an officer of the 'expert' class should be given the fullest opportunity of advancing his views and opinions, if necessary, in the presence of the ultimate authority, namely, the Minister It accordingly advocates the development of the board system as it obtains in the larger and more progressive industrial undertakings At the same time, the Guild states that it is necessary, in order to attract men of first rate scientific and technical ability to the Civil Service, that "steps should be taken to remove the idea that the status of the officers performing scientific and technical duties in the Civil Service is inferior to that of the administrative and clerical groups"

THE heads of the larger and more important professional, scientific, and technical departments of the Civil Service should the British Science Guild claims, be given the status accorded to the highest administrative officers The Guild doubtless has in mind the fact that whereas there are some thirty 'administrative' posts carrying a salary of £3000 per annum and a greater number with a salary of £2200, there are only some three or four posts on the professional or scientific side with a salary of as much as £2500, the remainder receiving in every case less than £2000 The Guild further maintains that the fact that an officer with administrative gifts happens to be a professional man should not in practice debar him from administrative preferment Finally, it is urged that the time is ripe for a simplified structure for the technical services—using that term in the broadest sense—based on their essential underlying unity, namely the discovery and application of scientific principles for the good of the community and the increased efficiency of the services administered by the State, and in this connexion, reference is made to the proposals for such a simplification which have been put forward by a Canadian Royal Commission for the assimilation to seven grades of an 'unnecessarily cumbrous" structure of 203 separate professional, scientific, and technical grades

THE Commission appointed by Congregation in March 1930, to advise the University of Oxford as to the best method of securing such library provision as shall be abreast of modern requirements, has issued its report The report is marked "confidential", but its principal contents are matters of common knowledge, and are now being freely discussed The only portion of the report that directly affects the scientific interests of the University is that dealing with the present condition and future development of the Radcliffe Science Library, now housed within the precincts of the Museum The building known as the Radcliffe Camera was the first home of the scientific and medical library provided and maintained under the bequest of Dr John Radcliffe in the early days of the eighteenth century In 1860, the scientific and medical books were removed, with the consent of the Radcliffe Trustees, to quarters in the recently established Museum in the Parks, here they remained until in 1901 the present building the gift of the Drapers' Company, was completed and ready to receive them Since 1927, the Science Library has become the property of the University it is administered by the Bodleian Curators, the Radcliffe Trustees contributing £1500 a year towards its maintenance The Commission reports that the present system is well adapted to the needs of workers in science, but it is considered that further accommodation for books and staff is essential A prolongation towards Parks Road and northward along it is recommended, the extended building being roughly L shaped

THE British Arctic Air Route expedition in Greenland has sent a note, published in the *Times* of Mar 18, on its plans for exploration during the coming summer One of the aeroplanes is badly damaged and the other requires some repairs, but both will be available to relieve the party on the interior ice cap and to support

a party that is to explore the coast regions to the north of the base on Sermilik fjord This party set out with dog teams on Mar 14 to map the inland edge of the ice free margin of the coast between Sermilik fjord and Kangerdlugsuak fjord They are travelling on the edge of the ice cap and hope to explore a lofty mountainous area which the expedition sighted last year, at the head of the last named fjord This is approximately the region named Schweizer Land by Quervain in 1912 It contains at least one peak more than 11,000 ft in height The coast of this stretch of land was mapped in detail last summer A second party is to move south from the base, mapping the coast, which is little known, for about a hundred and fifty miles This party will travel relatively easily over the sea ice and obtain plenty of food from seals Sermilik fjord is also to be re surveyed Thus the entire expedition will be in the field during the spring and summer months Mr H G Watkins, the leader, believes that if an air route over Greenland to Canada proves feasible, it will cross the east coast between Angmagssalik and Kangerdlugsuak fjord

ON Mar 18, the Symons Memorial Lecture was delivered before the Royal Meteorological Society by Comdr E C Shankland, his subject being "Navigation from the Viking Period to the Present Day in relation to Science and Meteorology" Comdr Shankland sketched the probable ideas which lay at the back of the Vikings' schemes for voyaging first westward then south westward, and finally making voyages of more than 2000 miles The information of climatic conditions existing in the ninth century which we possess from reference to early literature provides an interesting possibility that there was an extremely dry period for several years As without precipitation there can be no surface moisture and consequently ice, the presumption that many parts of north Europe, such as Greenland, now perennially ice covered, were dry and open for exploration, may have induced the Vikings to venture afield to some remote places overseas So much of the world's navigation history has been made and adventure commenced in the North Atlantic (either from the British Isles, Scandinavian, or Continental seaports), that the use of an elementary sextant to maintain the measurement of latitude by the polar star was, in Comdr Shankland's opinion, used prior to the compass or lodestone in Europe Cargoes carried by ships are the product of the land, and any port enjoying trading facilities and relations with the more habitable portions of the earth must be at an advantage if centrally situated The want of local knowledge of the weather in the North Sea and Irish Sea was probably the greatest meteorological event in our history, as it contributed towards the loss of the Spanish Armada and so gave Britain the freedom of the seas Among modern practices, the wind pressure on ships, and the utility of the barometer in gauging the lifting power of salvage pumps in salvage operations, were explained

WITH the current issue for March, *Antiquity* enters upon the fifth year of its existence Those who are responsible for its publication have earned congratulation and deserve every support *Antiquity* has shown that it is possible to maintain a high level of scientific interest with a style and form which will appeal to the average educated reader In the current number, the editor takes advantage of the fact that his editorial notes are written in an oasis of southern Tunisia to discuss the possible relation of the type of dwelling of the troglodytes of the Matmata hills, twenty seven miles south of Gabes, of which the unit is the single cave room, with the cave dwellers of palæolithic times and the megalithic temples of Malta Mr Crawford contributes an article on "Historical Cycles", and Prof Elliot Smith deals with the discovery of primitive man in China Prof Gordon Childe reviews the results of four years' excavation at Skara Brae, Orkney, for which he inclines to a Bronze Age date Mr Stuart Piggott discusses the possible origin of the Uffington White horse, on the basis of an interesting comparison with the horse design of early Iron Age coinage Mr C Hawkes's paper on hill forts, based on evidence from such as have been examined, is a pregnant study of distribution, which illustrates both by its inclusions and its omissions the comments in our issue of Mar 21, p 429, on the need of an archæological survey in Great Britain and co ordination and co operation in future research

SINCE 1874 the State of Illinois, U S A, has carried on a State Laboratory of Natural History, which in 1917 became merged with the State Entomologist's Office, to form the Natural History Survey Division Many valuable papers have been published by the workers of the Survey and their predecessors, dealing in large part with the systematic characters of different groups in the fauna of the State But more general papers, discussing, for example, the ecology of various types of country, have also appeared frequently in the series, and it is interesting to see that so long ago as 1880, Stephen A Forbes, the present chief of the Survey, was writing "on some interactions of organisms", on the food of birds, on insectivorous beetles, and still earlier on the crustacea eaten by fishes Since 1876, the *Bulletin* has been published, and now the Survey publishes a 29-page pamphlet containing a "Classified List of Publications", in which the titles of all papers and reports not out of print are arranged under subject and author headings The endeavour of the State in publishing its reports is to increase and spread the knowledge of the plant and animal life of Illinois, and, with this end in view, the Survey is prepared to distribute its papers, so far as reprints are available, to organisations and individuals willing to use them to stimulate further interest in natural history as a feature of public education Those interested should apply for the Classified List of Publications to the Chief, State Natural History Survey, Urbana, Illinois

THE Lane Lectures on Experimental Pharmacology and Medicine for 1927 were to have been given by Prof Rudolf Magnus, of the University of Utrecht, but his untimely death that year prevented the fulfilment of this plan Three of the five lectures con-

templated had, however, been completed, and these are now published under the editorship of Prof P J Hanzlik in the Publications of Stanford University, California (Medical Sciences, vol 2, No 3 1930) The lectures are entitled "A Contribution to the Experimental Pathology of the Lungs", "Choline as an Intestinal Hormone", and "The Physiological 'A priori'", and deal with certain aspects of physiology in which Prof. Magnus was interested and had carried out investigations The monograph, however, contains, in addition, a biographical note by Dr H H Dale and a list of Prof Magnus's works, compiled by Dr A de Kleijn, which considerably enhance its value Prof Magnus will be remembered chiefly for two investigations the first, carried out at Heidelberg, showed that the smooth muscle coats of the intestine retained their vitality and many of their activities when the organ was suspended in warm oxygenated Ringer Locke solution the second, carried out at Utrecht and occupying the greater part of his eighteen years at this University, on the factors controlling the changes of animal posture This work was published a few years ago in the great monograph, "Körperstellung" But the bibliography shows that his interest in pharmacological problems continued throughout, and in fact two of them formed the subject of the Lane lectures

THE diagnostic and therapeutic uses of the applications of electricity in medicine and surgery are continually growing in value It is only recently that any attempt has been made to rationalise the electrical apparatus used in accordance with electrical engineering standards We consider, therefore, that the paper on the medical and surgical application of electricity read by Dr Bernard Leggatt to various centres of the Institution of Electrical Engineers and published in the February *Journal* will prove very helpful He considers that the great value of this branch of electricity is not generally recognised in Great Britain In the diagnosis of disease, the combined services of the pathologist and radiologist are responsible for about 95 per cent of all positive diagnoses, hence it is surprising that on most hospital staffs these two specialists are not considered of sufficient importance to have seats on the hospital medical committee The applications of X rays, which present the widest field at present both for diagnosis and the treatment of specific diseases, are discussed at length Great differences of opinion exist as to the relative value of gas and electron X ray tubes These differences are easily explicable, when we consider the physics of the problem Any dangerous electrical apparatus can be installed in a hospital without supervision and operated by persons entirely ignorant of electricity, as, unlike workshops and factories, there are no Home Office regulations applicable The best methods of producing ultra-violet radiation and of measuring its dosage are described The use of high frequency currents to heat the tissues of the body to any desired degree is favourably commented on, and also the uses of the electrocardiograph Some of the electrical treatments which have been suggested and are sometimes employed are of questionable value

THE Report on the Investigation of Atmospheric Pollution in the year ending Mar 31, 1930, issued by the Department of Scientific and Industrial Research, is a quarto pamphlet of 74 pages and costs 4s (London H M Stationery Office) According to it, the average amount of solid matter washed out of the atmosphere by the rain, at the 70 stations where observations are made, is slightly less than last year, but at 5 of them (in Burnley, Liverpool, Newcastle on Tyne, Rochdale, and Rotherham) it still exceeds 760 tons per square mile per annum, while very few get less than 100 tons per square mile per annum When there is no rain to wash it out, this matter is present in the atmosphere at the rate of 1 or 2 milligrams per cubic metre of air, and may be carried down the wind for many miles In London and Glasgow, domestic fires account on the average for 75 per cent and industries for 25 per cent of this solid material While in the air, it obstructs the passage of light and particularly of ultra-violet light, and the observations at Rochdale show that 29 per cent of the ultra violet light which reaches the outskirts of the town, where the pollution is less, is lost at the centre of the town, where the pollution is greater

A CHEMICAL library of historic interest has just been discovered in the Bodleian Library by Dr R T Gunther, who has published a list of twenty three of the books in the recent issue of the *Bodleian Quarterly Record* The greater number of the volumes now described were given, in 1683, by various benefactors to form the nucleus of a departmental library when the Ashmolean Chemical Laboratory was opened, as described in NATURE for April 2, 1927 The existence of this venerable collection of books, the oldest public chemical library in Britain, had long been forgotten owing to loss and dispersal of its volumes to fill gaps in the series of Ashmolean manuscripts, with which it had nothing to do Fortunately, the names of donors have been inscribed in several of the books, thus establishing their identify The more important gifts came from the vice chancellor, the dean and other members of Christ Church, from Dr Plot the first professor of chemistry, and from John Cross, the 'privileged' apothecary at whose premises, in the Oxford High Street, Boyle and Hooke conducted their epoch making researches in 'pneumaticks' None of the books is recorded as having been presented by Ashmole, although he was the founder of the professorship of chemistry

IN connexion with the total solar eclipse on Aug 31, 1932, which will be visible in Canada and the United States of America, it is hoped to organise two tours from Great Britain Tour 'A' will leave on or about July 22, and, after landing at Montreal, will proceed to Victoria, B C, by the Canadian Pacific Railway The return journey will be through North America, arriving at Boston on or about Aug 30 All the more important observatories will be visited Tour 'B'

will leave on or about Aug 12, and will not be such an extensive one, but will arrive at Boston about the same time as tour 'A' A joint attraction is the meeting of the International Astronomical Union under the presidency of Sir Frank Dyson, the Astronomer Royal, which will be held at Harvard as soon after the eclipse as possible Members of either tour may have their ocean tickets made available for return directly after the eclipse or after the meeting of the I A U Further information may be obtained from the Assistant Secretary, Royal Astronomical Society, Burlington House London W 1

THE tenth anniversary of the founding of the first birth control clinic by Dr Marie Stopes was celebrated by a dinner at the Ritz Hotel on Mar 17, when a distinguished company assembled to congratulate her upon the success of her campaign Since the opening of the clinic direct personal instruction has been given through lady doctors and midwives to more than twelve thousand cases, mostly very poor women, who have attended for advice and help Travelling clinics have been initiated which have done valuable service in South Wales and the industrial north It is important to remember that Dr Marie Stopes' society exists for "constructive birth control", and that therefore it is concerned with the positive control of conception and the production of desired children as well as the prevention of childbirth by contraceptive methods Information as to membership may be obtained from the Secretary, C B C 108 Whitfield Street, London, W 1

AN earthquake of moderate intensity was recorded at Kew Observatory at 8 h 16 m 38 s G M T on Mar 18 The epicentre is estimated to have been 7340 miles away The readings obtained at Kew, Fordham (North America), and Pasadena indicate that the epicentre of the shock was near lat 34° S, long 71° W, that is, near Santiago de Chili A moderate earthquake was also recorded at Kew Observatory at 6 h 38 m 31 s G M T on Mar 19 The epicentre is estimated to have been 6080 miles away, but the initial impulse was too small to give any indication of the direction

BY the will of Mr Montague Napier, one of the pioneers of the motor car and aeroplane engine industry, cancer research will eventually benefit to a considerable extent After several bequests have been made, the residue of the estate is left, subject to a life interest, "for the advancement of knowledge and the benefit of mankind by research, whether in the United Kingdom or abroad with the object of ascertaining the cause of cancer (including corresponding or allied diseases) and the means of its prevention, cure, and alleviation, in the discretion of his trustees" The amount available for charitable purposes is expected to be about £700 000

A SPECIAL exhibition of apparatus and equipment used in geophysical surveys was opened in the Science Museum, South Kensington, on Mar 21, and will remain on view for a period of three months The exhibits have been specially selected to illustrate the development of all the important methods at present employed in the location of mineral deposits by the use of sensitive physical apparatus, as well as the evolution of the instruments and apparatus used Details of field operations and the technique of the various methods are also represented, while in addition many examples are shown of results obtained by geophysical surveys in various parts of the world Several of these results, which are now made public for the first time, demonstrate, in a striking manner, the possibilities of geophysical methods of exploration, in revealing the characteristic features of subterranean structures and mineral deposits

AT the stated general meeting of the Royal Irish Academy held in Dublin, Dr R Lloyd Praeger was elected president in succession to Prof R A S Macalister The following officers were also elected Treasurer, Mr F E Hackett, secretary and secretary to the Science Committee, Prof J J Nolan, secretary to the Polite Literature and Antiquities Committee, Mr T P Le Fanu, librarian, Dr E J Gwynn, resident secretary, Mr A Farrington New members elected included Mr T S Broderick, lecturer in mathematics and statistics, Trinity College, Dublin, Prof T Dillon, professor of chemistry in University College, Galway, Rev H V Gill, *S J*, author of numerous papers on physics and geophysics, Dr J H J Poole, lecturer in physics in Trinity College, Dublin Elections to honorary membership included Prof Erwin Schrödinger, Berlin, distinguished for his work in theoretical physics, and Prof Ludwig Diels, Berlin, for his eminent work in systematic botany

A USEFUL catalogue of books in a new condition, on all branches of chemistry has just been issued by Messrs H K Lewis and Co, Ltd, 136 Gower Street, W C 1 Being carefully classified, it should be of service for reference purposes

LIBRARIANS and others wishing to add to their store of scientific periodicals or to fill up gaps in those upon their shelves should obtain a copy of *Periodica*, New Series, No 4, just circulated by Messrs W Dawson and Sons, Ltd, Cannon House, Pilgrim Street E C 4, in which upwards of 700 scientific serials are listed

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A whole time instructor of metalwork at the Shoreditch Technical Institute—The Education Officer (T 1), County Hall, S E 1 (April 1) An agricultural inspector under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (April 7) A lecturer in geography at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (April 11) A science master at the Royal Naval College, Dartmouth—The Headmaster, Royal Naval College, Dartmouth (April 13) A superintendent of instruc

tion in the principles of boot and shoe manufacture under the Northamptonshire County Council Education Committee—The Secretary for Education, County Education Offices, Northampton (April 13) A Dickinson research travelling scholar in medicine, and a Dickinson research surgery scholar at the Manchester Royal Infirmary—The Secretary to the Trustees, Royal Infirmary, Manchester (April 18) An assistant lecturer in geology at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (April 18) A lecturer in physiology in the University of Bristol—The Secretary and Acting Registrar, The University, Bristol (April 24) An assistant lecturer in education at the University College of Hull—The Registrar, University College, Hull (May 6) An assistant lecturer in geography at the University College of Hull—The Registrar, University College, Hull (May 9) A professor of chemistry in the University of Sheffield—The Registrar, The University, Sheffield (May 15) A Pilkington fellow in cancer research, an Amy Henriotta Worswick fellow for the investigation of the causes and treatment of rheumatoid arthritis, and a Knight fellow for the study of the factors concerned in the development of the symptoms of mental disturbance, in the University of Manchester—The Registrar, The University, Manchester (June 1) A temporary lecturer in educational psychology and hygiene at Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S E 14 A research fellow at the Liverpool and District Hospital for Diseases of the Heart—The Secretary, Heart Hospital, Oxford Street, Liverpool A junior chemist at the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, 2 Idol Lane, Eastcheap, E C 3

Our Astronomical Column

Total Eclipse of the Moon—It is several years since a total eclipse of the moon has been visible under favourable conditions in the British Isles Advantage should therefore be taken of the occasion on April 2, though the moon's altitude will not be great In London, the sun sets at 6 33 P M, the first contact with the umbra having occurred 10 minutes earlier, totality begins at 7 22, and lasts for 1½ hours, the last contact with the umbra is at 9 52

Observations of occultations of faint stars during totality can be utilised for obtaining improved values of the moon's diameter and parallax, also studies of the colours and degrees of brightness of various regions of the moon's disc enable inferences to be drawn as to the transparency of the earth's atmosphere in the regions where the moon is on the horizon Mr L Richardson contributed several papers to the B A A *Journal* on this subject, he showed that it is only the lower layers of the earth's atmosphere that are effective in refracting light to the central regions of the umbra

Who discovered Jupiter's Satellites?—J H Johnson, in the B A A *Journal* for January, vindicates the claim of Simon Mayer to have discovered the four great satellites of Jupiter some days before Galileo, and to have deduced better values of their distances from Jupiter and their periods than those of Galileo He gives long quotations from the original documents, and refers to J Bosscha's paper in *Archives Néerlandaises des Sciences*, 1907 Galileo himself denounced Mayer, but his attacks appear to have been unjust, and a good deal of evidence is given in the paper that Mayer's work was independent His values for the diameter of Jupiter and the radii of the satellite orbits suggest that his telescope gave better definition than Galileo's did He received two excellent lenses made by John Baptist Lenccius, of Venice, early in 1610, but he had observed the satellites with another telescope in December 1609 In explanation of the fact that neither he nor Galileo noticed satellite IV on Jan 8, 1610, it is pointed out that it was then at elongation, far outside the other satellites, and that there were other stars of similar brightness near it Mayer was the first to publish tables of the satellites Bakhuyzen has shown that a fixed star which Mayer inserted in a sketch taken on Dec 30, 1610, is in the right place, this adds weight to the genuineness of Mayer's observations Most modern works continue to give Galileo's name as the sole discoverer, so it is well to direct attention to Mayer's claims

Eros—Signor L Jacchia, of Bologna, discusses the light variation of Eros in *Astr Nach*, 5761 He finds for the period of variation 0 10973 days, most observers consider that the true period is twice as long, being formed of two waves that are similar to each other but not quite identical The magnitude at minimum changed from 12 04 on Oct 27 to 10 96 on Nov 23 The amplitude of the light variation is given as 1 12 magnitude on Oct 22, 1 08 magnitude on Nov 12, 1 26 on Nov 23

Report of the Naval Observatory, Washington, for 1930—Details are given concerning the sending and reception of wireless time signals The maximum error of the Annapolis signal was 0 21 sec, the average error 0 038 sec The signals from Rugby and Bordeaux were received on most days

The Nautical Almanac for 1933 is practically completed The list of stars with ephemerides has been increased by 36 A new star catalogue is being formed from 72,330 observations made with the 9-inch transit circle between 1913 and 1926 A table comparing the mean declinations of fundamental stars in different zones with those in various standard catalogues is given in the report The 26 inch equatorial was used for observing the satellites of Jupiter and Saturn, also comets, minor planets, and occultations of stars by the moon Photography of the sun was continued, photographs were secured on 308 days, which is a record number The connexion of sunspots with magnetic disturbances and radio transmission is being investigated Predictions of magnetic storms have been occasionally issued by post card An expedition was sent from the observatory to Honey Lake, Calif, for the eclipse of April 28, 1930 The corona could not be photographed, but the position of the central line was fixed, and found to be very close to the predicted one A collection of 625 books belonging to Prof Asaph Hall, jun, was presented by his widow to the observatory

Visitors are admitted to the observatory on Thursday evenings, 2824 visitors came during 1930 and they were shown objects of interest with the 12 inch equatorial

Research Items

Population and Immigration.—In 1751, Benjamin Franklin wrote his "Observations Concerning the Increase of Mankind and the Peopling of Countries" and concluded that the importation of foreigners into a country does not necessarily increase the population, but that if the immigrants are more industrious and frugal "they will gradually eat the natives out". This thesis is supported by W. A. Rollins (*Jour. of Heredity*, vol. 21, No. 9), who analyses the census changes in the United States since 1650 and their relation to immigration. He shows how the originally high fertility of the early colonial stock declined very slowly until about 1850, when there was a great increase of immigrants, after which the decline was rapid. He also shows that for different parts of the country a high rate of immigration coincided with a low birth rate and vice versa, and that while the immigrants have been chiefly labourers, the fall in the birth rate has been most marked among university graduates, the ultimate effect being the replacement of the educated stocks by immigrants and their descendants. The character of the population of New England has been deteriorating in this way at least since 1850 and probably earlier, and the author suggests that the cycles of civilisation are sometimes correlated with a differential birth rate, the ascent taking place during a period when superior stocks have more children than inferior ones.

Mound Burial, Beech Bottom, Ohio.—The excavation of a small mound on the Ohio River in July–August 1930 is recorded by Charles Bache and Linton Satterthwaite, jun., in the *Museum Journal* (Philadelphia), vol. 21, Nos. 3-4 (Sept.–Dec. 1930). The mound was found to contain a grave in which was a skeleton richly decorated with shell and copper beads. Objects in considerable numbers were found in the sand thrown from the grave and the dark earth which had been used to fill it. Stone objects for the most part were of flint or flinty material, in number 116, of which 70 were thin blades, stemmed or leaf shaped, averaging about 10 cm. in length. The remainder were small points and scrapers. More remarkable was the persistent occurrence of tubes, all, with one exception, of grey pipestone. Thirty-two were found. Of these, seven were complete, two being entirely unbroken. The lengths ranged from 10.8 cm. to 31 cm., the maximum diameter being 2.3–3.8 cm. Ten celts were found, some of hæmatite. Tubes similar to those found here have been found but rarely, especially of such size and in such number. Various uses have been suggested, such as shaman's blowing or sucking tubes, whistles, and so forth, but there has been some disinclination to regard them as smoking pipes. In two, a clay and a charcoal pellet were discovered. In similar cases elsewhere it has been suggested that these were intended to keep the liquid generated in smoking from the mouth. The breaking of the tubes had taken place prior to excavation, and, it is believed, was intentional for ritual purposes. It is suggested that the mound belongs to the Adena culture of the Ohio area. This culture is little known and is only now beginning to be defined. Its chief characteristics are small conical mounds, singly or in groups, uncremated burials in log cists, the use of copper, mainly as ornament, the use of mica, sculpture in the round, and the use of tubular tobacco pipes. The culture is linked with the little-known culture of the Kanawha Valley, West Virginia.

Pearl Fisheries of Sulu.—Florencio Talavera in a paper published in the *Philippine Journal of Science* (vol. 43, No. 4, 1930) has brought together much information on the present situation of the pearl fishery in the Sulu Archipelago. This is a large natural pearling ground, the largest and most prolific in the Philippines, bounded by the Sulu Sea on the north and the Celebes Sea on the south and east, extending for 137 miles in a south-westerly direction from Basilan to Borneo, and consisting of two main groups of islands divided into many smaller islands, islets, and reefs. In the deep water, there are 'pockets' or pearl beds that serve as natural nurseries from which millions of eggs are produced and scattered by the currents, and these settle on the shallow banks. This constant supply is apparently the explanation of the fact that the pearl beds have not been depleted after many years of fishing. The north-east and south-west monsoons naturally regulate the fishing, bringing about a rotation in the working. The Philippine pearl oyster *Margaritifera maxima* grows rapidly, for there are no cold spells to retard its growth. It is sexually mature in two years and attains 14 cm. "nacre measurement", the "present legal size", in about three or four years. It is recommended that this minimum legal size be altered to an outside measurement, as it is difficult to measure accurately the extent of the nacre, and that the Departmental order which restricts the fishing to certain times be rescinded. The present fleet is apparently too small to do any serious damage to the fisheries, and the pearling boats do not as a rule work on the known grounds only but do a considerable amount of prospecting, new beds being discovered continually. It is also recommended "that no protective measures for all beds or any banks within the Sulu Archipelago be adopted until after a careful study of the fisheries shall have been made".

A Study of Mangrove Crabs.—Dr. J. Verwey has done a most valuable piece of work which is described fully in his paper "Einiges über die Biologie Ostindischer Mangrove-Krabben" (*Treubia*, vol. 12, 2, 1930). The fauna of a mangrove swamp is peculiarly specialised and the crabs live in and out of the slimy mud, each species in its own zone and each individual in its own territory. Notes on the mollusca of the different zones are also given, but the main part of the work is on crabs, especially *Uca signatus*. The genera *Sesarma*, *Metaplax*, *Ilioplax*, and *Scylla* are all represented. The account of their habits and their adaptation to the environment is specially interesting. Five zones are recognised, each zone inhabited by different crabs and molluscs which have certain characteristics in common. They are able to withstand much change of salinity; most of them eat the slime and extract nutriment from it, chiefly minute plants and animals; many of them are amphibious, breathing either by gills or by lungs; all of them dig burrows, of various depths, which reach the underlying water. The peculiar habit in fiddler crabs of waving the large claw is believed by the author to be a demonstration of territorial rights, and not, as is sometimes thought, a calling to the female. It apparently goes on almost continuously. The habit appears to belong only to those species which live very close together, with their burrows adjacent, each feeding on the slimy mud around its own special home. The paper is illustrated by clear diagrams of the burrows, text-figures of the crabs and their appendages, and beautiful photographs showing the various habitats.

The Reproduction of *Polystomella*.—We have to thank Mr. E. Heron-Allen, for the publication of the original notes of Dr. J. J. Lister on the reproductive

processes in *Polystomella crispa* (*Smithsonian Miscellaneous Collections*, Publication No 3067 Volume 82, No 9, 1930) Dr Lister's work on the reproduction of the megalospheric form of *Polystomella* by means of flagellispores has been familiar to zoologists for more than thirty years, and it was also known that he had completed the study of the microspheric form, but although the gist of this work had been published, the actual paper had never appeared This unpublished paper was found after Dr Lister's death and completed and edited from his note books by his friend Mr Heron Allen In 1894 the paper on the megalospheric form was published in the *Philosophical Transactions* of the Royal Society The later work on the microspheric form was only published as a postscript to the earlier paper, and this postscript, slightly elaborated, appeared in his "Foraminifera" in Lankester's "Treatise on Zoology" in 1903, in his presidential address to Section D (Zoology) at the York meeting of the British Association in 1906, and in his evening discourse at the Royal Institution in 1907 The protoplasm of the microspheric form of *Polystomella* emerges from the shell and breaks up into small spheres, each of which becomes a megalosphere Details of the process will be found in these notes, with very beautiful photomicrographs published now for the first time The whole of the note books, slides, and photographs have been presented by Mrs Lister to the Heron Allen and Earland Library and Collection at the Natural History Museum, London

Stalked Buds in the Coral *Echinopora* —Dr H Boschma and Dr J Verwey, in their paper "The Occurrence of Stalked Buds in the Coral *Echinopora lamellosa*, Esper" (*Treubia*, vol 12, 2, Oct 1930), describe the frequent presence of small stalked corallites on the under side of colonies which are partly exposed to light These have been noticed before by Dr Boschma in specimens from a small island in Sunda Strait, but they are now found to be common in the colonies of *Echinopora* in the reefs of the Thousand Islands (especially those of the Bay of Batavia) These corals occur both in sheltered and exposed situations, their form differing in different habitats The principal factor governing the development of these stalked buds appears to be light, but the corallum must have a certain thickness before the buds are formed The paper is illustrated by interesting photographs

Changes in the Proteins of Ripening Rice Grains —Takadoro and Abe (*Jour Faculty Agric*, *Hokkaido Imp Univ*, **27**, 349) record a large number of changes in the composition of rice grains during the last three weeks of their development If correct, some of these are of a fundamental nature, for a study of the nitrogen distribution in the protein extracted as oryzenin shows striking changes during ripening While histidin nitrogen was found to increase progressively, most of the other nitrogen fractions show a maximum or a minimum about ten days before the grains ripen Amide nitrogen, monoamino nitrogen, and particularly cystine nitrogen fall to a minimum at this time Diamino nitrogen, however, shows a maximum, apparently due chiefly to a maximum of arganine In the same way, there is a minimum of ash and of phosphorus, but, curiously enough, a maximum of sulphur in spite of the low cystine The isoelectric point of oryzenin fluctuates in accordance with these changes from pH 4 75 to pH 5 08, being highest when the diamino nitrogen is at a maximum

The Estuary of the Sussex Ouse —Using both physical evidence on the ground and documentary evidence from old maps and descriptions, F G Morris has traced the changes in the mouth of the Sussex Ouse and the effect of these changes in the destinies of the towns of Seaford and Newhaven The account appears in *Geography* for March, and is a useful record to the history of changes in the English coast line In the thirteenth century and probably earlier, Seaford was a port of considerable importance lying in the estuary of the Ouse about a mile north west of Seaford Head The sea did not then reach the chalk spurs of Blatchington and Hawth Hills, which had the river at their feet, separated from the sea by a broad shingle spit that no doubt had been piled up by westerly winds and diverted the river mouth to the east This shingle spit was breached in the sixteenth century and a new river mouth resulted on the site of Tide Mills, which became Newhaven Thus the old port of Seaford was rendered valueless and in time silted up The present outlet of the Ouse dates from the seventeenth century and would appear to be partly artificial Near the mouth was the port of Meeching, which eventually became Newhaven when the original port of that name was rendered valueless by shingle drift and was abandoned The old course of the Ouse is now represented in part by Mill Creek

Excitation of Zinc and Cadmium Spectra —A very full study of the intensity of lines in the spectra of cadmium and zinc when excited by electrons of a definite speed is described by K Larché in the *Zeitschrift fur Physik* for Feb 6 The excitation functions, which vary for different types of transitions in the way referred to by Mr Massey and Mr Mohr in their recent communication to NATURE (Feb 14, p 234) also agree very well with those previously found for the allied spectra of mercury Perhaps the remaining point of least definiteness now is the existence of more than one maximum in the excitation curves for certain lines There is a doubt as to whether this is essentially an atomic phenomenon, or due to the conditions in the discharge tube The results of different observers are not always consistent, and in one case, that of the negative bands of nitrogen, a triple maximum has been reported Dr Larché believes that there is a relation between the sharpness of the maximum in the excitation curves and the average life time of the atom in the excited state from which the transition starts—a long lived atom appears to have a sharp excitation function, and an atom with a short life an excitation function with a less pronounced maximum—and in one case, that of the $1^1S_0 - 2^1P_1$ resonance line of cadmium (2288 A), points out that the double maximum of the excitation function has its counterpart in the existence of two different values for the life time

Inductance Coefficients in Electrical Engineering —In electrical engineering, very considerable use has been made of inductance coefficients in connexion with distributing mains, since Maxwell and Lord Rayleigh first gave the requisite formulæ Recently, in everyday work, it has been customary to compute the inductance coefficients for parts of a circuit The assumption is frequently made that there is a coefficient of 'mutual' inductance connecting these partial coefficients In the February issue of the *Journal* of the Institution of Electrical Engineers, Dr A Russell points out that this is not the case and gives the requisite formulæ He also lays stress on the limitations of these formulæ in practical work, as most of them depend on the assumption that the current density is uniform over the cross section of the cable With high frequency currents this assumption is not permissible, the current distributing itself

in such a way that no magnetic effect is produced in the metal of the conductor This he calls the 'Heaviside' effect He proves that although sheath losses can be computed in certain cases by means of inductance coefficients, the method fails when the sheath surrounds two or more cores carrying polyphase currents In this case, the instantaneous value of the algebraical sum of the currents flowing through a cross section of the sheath may be zero This shows that some of the currents in the cross section are flowing in one direction and some in the other The current density varies both in magnitude and phase as we go round the cross section Many new formulæ are given and some of the old ones are given in forms more convenient for computation

A Neon-tube High Tension Voltmeter —The difficulties that have been experienced in devising voltmeters which will read pressures of 100 kilovolts and upwards have led designers to invent instruments which depend on the distance between spherical electrodes when sparking occurs to give an indication of the voltage Corrections for temperature and pressure have to be employed, and the voltage found is the crest or maximum voltage The effective voltage required in practice can only be known when the law according to which the voltage varies has been determined In many cases, however, especially with modern generators, the assumption that the voltage follows the harmonic law suffices, and so we can deduce the effective voltage from the crest voltage by dividing it by the square root of two Dr L E Ryall read a useful paper to the Institution of Electrical Engineers on Feb 6, on the use of a neon tube as a high tension crest voltmeter The accuracy of the method depends in a large degree on the constancy of the striking voltage of the neon lamp when arranged as a voltmeter To test the lamp, it is made part of a neon tube oscillator consisting of a variable air condenser (0 001 μF max) in series with a resistance of one megohm and a telephone receiver across a direct current supply of 400 volts The lamp is in parallel with the condenser, and the capacitance of the latter is reduced until oscillations cease It is found that, if the lamp has permanent characteristics, the frequency of the oscillations can be increased above the audio range (about 20 kilocycles per second) and the capacitance can be reduced to less than 50 $\mu\mu F$ before oscillations cease When this occurs, there is a sudden change in the appearance of the glow By subdividing the voltage by a condenser divider, it was found that the tube could be used very satisfactorily as a sub standard voltmeter

Liquid Diffusion —The January number of the *Journal of the American Chemical Society* contains a paper by McBain and Tsun Hsien Liu on the diffusion of electrolytes, non electrolytes, and colloidal electrolytes The authors combine the Nernst formula for the diffusion of an electrolyte with that of Einstein for uncharged spherical particles or molecules very large in comparison with those of water, and conclude that a generalised equation for the diffusion coefficient, D, will be $D = iRT/\Sigma(1/U_m)$, where $1/U$ is the resistance to movement of a particular species, iRT being the osmotic term The apparatus used was a Northrop diffusion cell with a diaphragm of sintered glass, and the experiments were very rapid and reproducible For simple electrolytes, the predominant factor is the van 't Hoff factor i, the data for potassium chloride being reproduced to within 2 per cent by the formula when i varied whilst the denominator remained constant This implies incomplete ionisation As an example of the method of summation of the effects due to different constituents in predicting total diffusion, the data for a typical soap solution were analysed and found to be in agreement with previous information The data for sugar solutions show that the viscosity contributed by the dissolved substance is not that which determines rate of diffusion The diffusion column of one substance may, by bombardment of its molecules, accelerate, retard, or even reverse the diffusion of another substance

Ortho-hydroxy Aldehydes —Malkin and Nierenstein in the January number of the *Journal of the American Chemical Society* describe some experiments on the acetylation of phloroglucin aldehyde which are of importance in connexion with the synthesis of flavylium compounds It was known that the usual coumarin reaction does not proceed when phloroglucin aldehyde is heated with acetic anhydride and anhydrous sodium acetate, the product of condensation consisting mainly of 2, 4, 6 triacetoxybenzylidenediacetate, melting at 155°-156° Pratt and Robinson, and Robertson and Robinson, by the action of phloroglucin aldehyde and acetic anhydride, in the presence of potassium carbonate, obtained a substance, melting at 156° 157°, which they considered to be triacetylphloroglucin aldehyde The analysis did not agree well with the formula of this substance, so that the presence of half a molecule of combined water was assumed Malkin and Nierenstein show that this so called triacetylphloroglucin aldehyde is the penta acetate compound prepared in 1903 by Herzig and Wenzel, and that the true triacetyl compound may be obtained by carrying out the acetylation in ether solution with acetic anhydride and potassium carbonate The material obtained by Robinson and Robertson has been the starting material in the synthesis of a large number of anthocyanidins

Constituents of Starch —The work of Maquenne and Roux supports the conclusion that natural starch is made up of two constituents, namely, insoluble amylopectin, which is responsible for the paste-forming properties, and soluble amylose ('artificial starch'), in the proportions of 80 and 20 per cent respectively Effront has recently attacked certain of their hypotheses (*Ann Soc Zymol pure et appliquée*, **2**, 5 , 1930) showing that amylose has the properties of a polysaccharide of the type $(C_6H_{10}O_5)_{18}\ H_2O$ and that it probably results from the hydrolysis of depolymerised starch, and cannot, therefore, be a mixture of reducing sugars with dextrins Amylopectin is characterised by the presence of phosphorus, probably in an ester combination, though the actual nature of the compound in which it is present may vary and produce corresponding variations in the power of gelatinisation of the starch Analogously, the amount of phosphorus present determines the solubility of the amylopectin The author goes so far as to suggest that differences in the properties of these two constituents of starch are due to differences in their physical as distinct from their chemical states The work of Nowopokrowsky and Tschebotarewa (*Kolloid Zeit*, **52**, 302 , 1930) supports the existence of these two substances, though the properties described are not in complete agreement with those observed by other workers These authors explain gelatinisation by the production of a concentrated solution of amylose inside the starch granules, followed by a contraction of the outer skin of amylopectin These papers illustrate the great difficulty, characteristic of studies on starch, in correlating results of different workers who approach the problem from different points and give the same names to substances which are not necessarily identical

The Relation of the Fauna and Flora of the British Isles to those of North America

AT the Linnean Society on Mar 5, Mr H E Forrest opened a discussion on "The Relation of the Fauna and Flora of the British Isles to those of North America" Mr Forrest first summarised the geological evidence on which his hypothesis is based There were two phases of the Great Ice Age (1) Ice-sheet period, (2) glacier period During the first phase the ice came from north west across the Irish Sea, during the second phase it came from the north-east

(1) The ice-sheet originated in the mountainous northern region of the Atlantean continent, which connected Europe with North America This gradually sank Eventually an arm of the sea intruded between the Faroes and Scotland this broke the continuity of the ice sheet and brought it to a stand still

(2) When the ice sheet became stationary, its south easterly thrust ceased Then the local glaciers had free play The Scottish Highlands and the Lake District produced glaciers on a big scale, and these sent forth streams of boulders which spread out west and south west to Ireland, North Wales, and the plain of Cheshire and northern Shropshire The glaciers lasted after the ice sheet had finally melted and gradually retired as the climate ameliorated

In the course of his investigations into the mammalian fauna of the British Isles, Mr Forrest has found that out of sixty four British species—recent and fossil—thirty-two are absent from Ireland The usual explanation is that these reached Britain after Ireland became an island But in the west of Ireland there are many plants and animals which do not occur in Britain Several—such as *Saxifraga umbrosa*—occur only in Spain and western Ireland

Among all classes of animals and plants, many species are common to eastern North America and western Europe Five sixths of American fungi are also British About a hundred phanerogams, including many fresh water plants, have similar distribution, whilst among invertebrates—especially insects and molluscs—examples are numerous

That there was a land bridge between Europe and America in the north is admitted Evidence was offered that there was also a connexion in temperate latitudes, that in place of the North Atlantic there was an Atlantean continent—the northern half mountainous, the southern a plain with great fresh-water lakes Mr Forrest suggests that this continent was the home of all British American species, and that some of them originated in it *Saxifraga umbrosa* undoubtedly did so, and other species classed as Lusitanian by Dr Scharff He also suggests that the Salmonid fishes, including *Coregonus* and *Salvelinus*, and the crustaceans *Mysis* and *Limnocalanus*, originated in the Atlantean Lakes

Dr C Tate Regan said that the examples given to support the hypothesis of an Atlantean continent are just as well explained by the supposition that the northern continents have occupied nearly the same areas since the Eocene, except for connexions between Asia and America across the Bering Sea, and possibly between Europe and America via Iceland The only European species found in North America are northern types that range through Siberia, such as the pike The Salmonids (char, whitefish) said by Mr Forrest to have come from the Atlantic continent are not true fresh-water fishes Char (*Savelinus*) are marine fishes that run up rivers to breed and form colonies in lakes those of the lakes of Ireland and Britain may have entered them in glacial times when our seas were colder and the limit of char in the sea was farther south

If in late Tertiary times the North Atlantic had been filled with a continent, one would expect nearly the same marine fauna on opposite sides of the Atlantic It is only the northern species (cod, herring, etc), found also in Iceland waters, that are common to America and Europe

Dr A B Rendle did not consider the existence of a North Atlantic continent necessary to explain the relations between the flora of the British Isles and North America Existing land areas north of the Atlantic represented an adequate connexion between Europe and America in view of the more favourable conditions known to have prevailed formerly in Greenland The presumed existence of the Atlantean continent suggested a greater similarity between the floras of eastern North America and south west Europe and the Mediterranean than was borne out by facts The Lusitanian element in the European flora finds a more satisfactory explanation as a European, not as an Atlantean outlier Some of the species common to Europe and North America, such as *Pteris aquilina* and *Potamogeton natans*, adduced as evidence by Mr Forrest, have a very wide distribution and have no bearing on the case The distribution of *Eriocaulon septangulare* is remarkable, but it seems unnecessary to invoke an Atlantean continent to explain it

Prof J W Gregory was reminded by Mr Forrest's North Atlantean ice cap of the once assumed north polar ice cap If the glaciation of the British Isles was by ice from a North Atlantic continent, some of its rocks should be found in the British glacial drifts In the absence of such material, the issue depends on the interesting cases of distribution to which Mr Forrest had directed attention

Mr J Ramsbottom said that Mr Forrest's summary seemed to lay unwarranted stress on the distribution of fungi The statement that five sixths of American fungi were British was based on a list published by Mr Carleton Rea and himself after a short visit to the eastern United States in 1926 The list included only larger fungi If the whole continent were considered and all classes of fungi, the proportion would be entirely different. Parasitic fungi were largely specialised to their host plants and consequently could only be common to the two areas where the hosts were The aquatic Saprolegniaceæ had many species in common but they were of world wide distribution The fact that the larger fungi of South Africa and other temperate regions have a large proportion of species in common suggests that fungi cannot be called in to give any support whatever to hypotheses of lost continents, and this is probably the same with all cryptogams having small spores

Dr O Stapf observed that he could not adduce any evidence in favour of Mr Forrest's views from the distribution of the so called Lusitanian elements. The simultaneous occurrence of so many species in Europe and in North America is probably very largely connected with a more northern land connexion in Tertiary times, such as is very generally admitted. A certain percentage, however, may be due to simultaneous northward radiation to both hemispheres from an old common area in the south, for example, *Ericaulon septangulare* and *Brasenia purpurea*, the latter now extinct in Europe There is evidence of an extension of the Lusitanian element along the

coast line which connected Ireland and Scotland with Norway across what is now the North Sea Along the same line northern elements spread southwards and have left relict stations so far south as Ireland, where they mingle with Lusitanian species in Clare Island, the cliffs of which harbour *Silene acaulis* and *Saxifraga hypnoides* in intimate contact This coast is the most westerly extension of land in this part of the Atlantic which we can safely postulate In dealing with such problems it is necessary to consider species not only in relation to their special distribution but also to those of their nearer and wider allies

Dr B P Uvarov stated that in studying zoo geographical problems it is necessary to apply ecological methods Orthopterous insects are particularly suitable for these studies, because of the very small number of British species Three zoogeographical groups may be distinguished amongst British Orthoptera The largest consists of species distributed across Siberia, northern and middle Europe This group originated in the Angara continent of geologists Amongst members of the Angara fauna there are some which occur in North America but they spread via north east Siberia The second element is the Lusitanian (Atlantic), their present distribution points to their having originated in dry rocky land at the latitude of the Mediterranean Sea and Canary Islands The third group belongs to families and genera now widely spread in the sub tropics and tropics, and they are obviously relics of an age when the British Isles together with the most of the northern hemisphere enjoyed a mild tropical climate

Mr A J Wilmott emphasised the point that, with the possible exception of *Saxifraga Geum*, no species of the Lusitanian element of the British flora occurs in North America These species must be relics in Ireland, since there has been no connexion southwards since the glaciation Moreover, these species are not particularly cold shy they ascend to considerable elevations in Ireland There are many species common to Europe and to North America, though the number is being steadily diminished by critical study There are a number confined to Europe and eastern North America, and Prof Fernald has found several restricted in America to the unglaciated parts of Newfoundland and the mouth of the St Lawrence We know that many species with limited distribution to day formerly had a wider area of dispersal There are species which are now known only in the eastern United States and Japan It may therefore be possible that a species occurring only in Europe and the eastern States was originally connected across Asia and not across an Atlantis, and too definite an inference should not be drawn from present day distribution alone A proper analysis of the whole flora may give indications of the history of its development

Dr G P Bidder pointed out that the distribution of the fresh water sponge *Heteromeyenia ryderi* given as western Ireland and eastern North America is from Hanitoch's list of Irish Fresh water Sponges (1895), whereas the later account of Stephens shows that this is one of the commonest sponges of Ireland but restricted to non calcareous districts and occurring in the island of Mull Miss Stephens gives no opinion on the distribution of *H repens*, which occurs in America over approximately the same area and has otherwise been recorded only from Galicia, though she holds that the distribution of *H ryderi* supports Scharff's hypothesis of a land bridge to America from Ireland

Forestry in Kenya Colony.

IN the previous Annual Report of the Forest Department of Kenya Colony and Protectorate, reference was made to the great drought of 1928 The recently published report for the year ending Dec 31, 1929, states that "the drought continued with ever increasing intensity for the first quarter of the year", but long rains followed and recovery was rapid One of the results of the drought was rather serious forest fires, occurring principally on the Aberdares and on the Mau The other visitation with which the Colony was afflicted was a plague of locusts, which, says this report, "showed signs of having passed its peak and being rapidly on the decrease, and a greater spirit of optimism prevailed generally"

Steady progress is being made with the work of selecting new forests for reservation and with the survey of the reserved areas It is pleasing to note that an earnest endeavour is being made to ascertain the degree of stocking in the various forests under exploitation by sawmills Enumeration of growing stock is proceeding apace and two working plans are in operation It had been proposed to form a special working plans party "but no staff was available during the year"

There are several forestry administrations under the Colonial Office to which similar remarks on the subject of inadequacy of staff are to be found in the annual reports It is to be hoped, now that prospects in those forestry services are really attractive, that young men of the right type will come forward for training For without sufficient and efficiently trained gazetted staffs real progress is impossible Under Financial Results, the Conservator (Mr H. M Gardner) writes "With only the comparatively small local market to depend on, it is not possible for the Department to produce a large net revenue It can be considered distinctly satisfactory if the Department can pay its way while the forests are being explored, developed, and brought into a more productive state As the forests are improved and communications become better, production costs will diminish, and it should be possible to develop much wider markets and to obtain a very handsome profit from the Colony's forests" The Conservator's optimism is probably quite justified, but it should be remembered that this will only be possible provided financial support is available to develop the forest estate

As a case in point, the opinion of the Government of India at the time a forest organisation was being introduced into that country, soon after the inauguration (in 1864) of the Indian Forest Service, may be quoted, for its application to several of the colonial forest services may not be out of place The following extract is from a Circular (Revenue—Forests, No 24, dated 23rd November 1867) issued by the Governor General, Sir John Lawrence, in Council, and forwarded with a covering dispatch to the Secretary of State for India "It appears expedient to the Governor General in Council, to state that there are certain cases in which the administration of forests must, like the Irrigation Department, undertake works of public utility the outlay on which, within one year, may not always be covered by the revenue of the year The rule that the forest expenditure shall always be covered by the revenue can, in its very nature, only apply to ordinary expenditure"

On the plantation work in Kenya being carried out the report is most informative 4000 acres were

undertaken during the year—the largest area so far accomplished in any one year, and this in spite of the fact that a large number of blanks, due to the drought of 1928, had to be filled up in the existing plantations before any new work could be commenced This afforestation work is undertaken in several different ways (1) The greater part of the plantations are made on land that has been clear felled for timber and fuel and then cleaned up and cultivated by forest squatters The work, in spite of difficulties, is cheap and efficient The method is analogous to the *toungya* method employed in Burma and elsewhere in India (2) When squatters are not available and when the Department is afforesting grasslands, the area is either ploughed and cultivated by contract or a small sum is paid for ploughing and the contractor is allowed to have the use of the land for two to three years before planting, or again, bush covered land is being afforested by planting trees in lines cut through the bush, the growth being slower, but the bush acting as a nurse to the young trees and keeping down weed growth Of the 4000 acres planted, 1063 acres were afforested by this method This represents an addition to the Colony's forest capital (3) In certain types of forest, for example, *Brachylæna*, *Ocotea*, and some *Podocarpus* forests, natural regeneration, with assistance, is sufficient to replace the timber cut (4) Special attention is being concentrated upon fuel plantations and various exotics are being experimented with, and private planting is being encouraged Both railway and public take large amounts of fuel, the former utilised from all sources, Government and private lands, 13,867,025 cub feet during the year As private resources are cut out, the demands will fall increasingly heavily on the Government forests Fuel is now being supplied in large quantities from *Eucalyptus* plantations formed on the sites of natural forest cut for railway fuel The demand for fuel for domestic and industrial purposes is increasing rapidly round Nairobi and is becoming more and more difficult to supply In a few years, however, large areas of plantations will be maturing, as well as large plantations of black wattle, which is being planted on private land for the production of tanning bark

Kenya is so much before the public at the present time that the operations of the Forestry Department, so far as they affect the future well being of the Colony, appear to merit some prominence

Marine Research in the Mediterranean

THE fisheries of Egypt, though small in comparison with the vast fisheries of the northern waters of Europe, are varied and interesting They comprise the sea fisheries along the northern coast of Africa in the Mediterranean, and in the Red Sea, the Nile and delta lake fisheries, the latter of which in 1928 supplied about three quarters of the whole weight of fish landed in Egypt, and also the valuable sponge fisheries of the North African coast lying in territorial waters between Alexandria and Sollûm, which furnish sponges unrivalled in the world for their excellence of quality

We have received the report of the fisheries for the year 1928,* and amongst other items of interest are given comparative figures of the yield in kilograms per unit area of fish from the delta lakes These lakes are of exceptional interest, extending over huge areas and never exceeding much more than a metre in depth; they form a link between the Nile and the sea, for into their southern margins empty the drains of fresh water that have been drawn from the Nile to irrigate the land, while all but one are connected with the sea The lakes are thus stocked both by fresh water fish and by fish entering from the sea By far the most important fish, however, are the grey mullet, which grow and flourish extremely well under the conditions existing in the lakes, and which, at certain periods of the year according to the species, leave on their spawning migrations for the sea Figures are given to show that during the last eight years the average yield of fishes from lakes Menzaleh, Brullos, Maryût, and Edkou together amounted to so much as 142 kgm per hectare Parallel figures are given for the North Sea as 17 3 kgm per hectare, and for cultivated carp ponds as 65 5-165 kgm For a natural fishery these delta lakes are therefore extremely rich

In 1924 the Office of Fisheries Research was closed down, it was reopened towards the end of 1927 by the appointment of Mr R S Wimpenny as Director of Fisheries Research In the report under review there is little of scientific work published, but it is evident that movements are on foot to establish a department sufficient to attack a few, at any rate, of the many problems of interest that Egyptian waters afford, not the least of which from a biological point of view would be a thorough survey of the conditions in the delta lakes themselves

The Government has ordered a small motor Danish seiner to explore the possibilities of the fishing grounds on the Egyptian coasts and a plea has been put forward for a marine laboratory and necessary scientific assistants, and also for a steam trawler for oceanographic research It is to be hoped that this will soon materialise The knowledge of the fundamental problems underlying the productivity of the sea is essential to fishery research, and, while to administrative officials the immediate gain may appear to be insignificant, it is certain that in the long run such work will prove its value It is to be hoped therefore, that the Egyptian Government will see its way clear to supply the means for the establishment of an active marine biological laboratory, situated as it would be amid surroundings of absorbing interest, with problems such as the interchange of faunas between the Red Sea and the Mediterranean and the effects of the Nile flood, it is certain that information would be forthcoming that would add much to our knowledge of life in the sea F S R

* Ministry of Finance Coastguards and Fisheries Service Report on the Fisheries of Egypt for the year 1928 By R S Wimpenny (Cairo Government Press, 1930) P T 5

University and Educational Intelligence

CAMBRIDGE —Smith's prizes have been awarded as follows —Mr H S M Coxeter (Trinity) Mr H R Hulme (Gonville and Caius) Rayleigh prizes have been awarded as follows —Mr H Davenport (Trinity), Mr B Kuttner (Christ's), Mr J C P Miller (Trinity)

LONDON —The following doctorates have been awarded *D Sc in Physics* to Mr J P Andrews, East London College, for a thesis entitled "Investigation into the Elastic and Plastic Behaviour of Materials" (*Proc Phys Soc*, 1925, 1931, *Phil Mag*, 1925, 1928–29, 1931) *D Sc in Geology* to Mr E Spencer for a thesis entitled "A Contribution to the Study of Moonstone from Ceylon and other Areas and of the Stability Relations of the Alkali Felspars", and a subsidiary contribution *D Sc in Physics* on Mr H Shaw for a thesis entitled "Interpretation of Gravitational Anomalies", and fourteen subsidiary contributions

Applications for grants in aid of scientific investigations bearing on agriculture to be carried on in connexion with a university, university college, or other approved institution or society in England and Wales during the academic year beginning Oct 1 next are invited by the Ministry of Agriculture and Fisheries Conditions on which the grants will be made are to be found on Form A 53/T G, copies of which are obtainable from the Secretary of the Ministry, 10 Whitehall Place, S W 1 The latest date for the return of completed forms of entry is May 15

Secondary education in England and America is the subject of an article by Dr Grizzell, professor of secondary education in the University of Pennsylvania, appearing in the December number of *School Life* This is the fortieth of a series of articles sponsored by the National Committee on Research in Secondary Education, and records some of the conclusions reached as the result of a carefully planned co operative study undertaken by a joint committee of experts of the two countries in 1928 Dr Grizzell recognises the existence in both of a tendency in the direction of wider educational opportunity for the adolescent, but the resultant general reorganisation has been more rapid in the United States The recent development in England of the higher elementary and central schools is compared with the high school movement which began in the United States almost a century earlier He notes also a tendency in both countries to extend the period of secondary education upward The 'junior college' movement in America is the counterpart of the development in England of two year courses of specialised study after the 'first' school examination, but is, to all intents and purposes, a separate institution and avoids extreme specialisation in the academic field The greater part of the article is devoted to a survey of contrasting practices and divergent tendencies which the author has observed in every important aspect of secondary education in the two countries Some of these differences are summed up in the dictum, "To the English teacher, education is dominantly an art, to the American it is rapidly becoming a science"

The United States Commissioner of Education, discussing, in his report for 1928 29, recent significant events and tendencies in higher education, gives the first place to increased scientific investigation of institutional problems and objectives Such investigations have been reported during the year by scores of universities Scientific and semi scientific methods of investigation have been ousting the older methods of philosophy and mere observance of tradition William James's passion for grappling with 'stubborn facts' seems to pervade the learned world, and this is attributed to necessity rather than choice, for the increasing industrialisation, machine production, changing of social customs, and other characteristics of a fast evolving civilisation make imperative a correspondingly rapid adaptation on the part of educational institutions, and for this they find themselves compelled to depend more and more on research and scientific study Changes in general organisation of collegiate work are illustrated by the rapid growth of 'junior colleges' (including the first two years of the traditional 4 years liberal arts college course) the increase in their number during the year amounted to 25 per cent Registration of full-time students in colleges and universities meanwhile increased by only 2 per cent With some of the pressure of numbers removed and with a continued increase in financial support, stress may now be put, says the Commissioner, on quality of output Institutions are studying, as never before, both the quantitative and qualitative demands by society for their human product

Birthdays and Research Centres.

Mar 29, 1890—Dr H Spencer Jones, F R S, H M Astronomer at the Cape of Good Hope

The erection of a large reflecting telescope in the southern hemisphere is an urgent need It should have an aperture of at least 72 inches, since, for many purposes, great light gathering power is essential, and it should be equipped with a spectroscope adapted for one, two, or three-prism dispersion Such a telescope would be available for determining the radial velocities of faint stars, and for the study of distant nebulæ and other problems which are beyond the reach of existing instrumental equipment The full interpretation of many observations obtained with large instruments in the northern hemisphere is dependent upon similar observations being secured in the southern hemisphere

In recent work, the need has been felt of a publication in which are summarised the analyses of spectra for which the multiplet relationships have been investigated The identified energy levels in the atom and the excitation potentials and multiplet identifications of individual lines should be given Many of the original papers are in publications which are not available for reference anywhere in South Africa.

April 4, 1852—Prof A P Coleman, F R S, emeritus professor of geology in the University of Toronto

Recent work along the St Lawrence and near Moose Factory and Churchill on Hudson Bay proves that the marine beds, long known in those regions, include not only postglacial deposits, as usually stated, but also interglacial beds The interglacial sea reached twice the height of the postglacial one The last glaciation in eastern America was much less massive than an earlier one, suggesting that the greater load of ice implied a correspondingly greater depression of the lowlands How close to isostatic equilibrium do such adjustments come, and how much lag is to be expected when the load of ice is removed? Have similar relations been found between interglacial and postglacial marine levels in northern Europe?

Societies and Academies.

London

Physical Society, Feb 6—E B Moss A ballistic recorder for small electric currents The standard thread recorder is so modified that it records ballistic throws in instead of the usual steady deflection By this means, the current sensitivity may be increased at least twenty five times—F J Scrase The instrumental phase difference of seismograph records an illustration of the properties of damped oscillatory systems A discussion is given of the method of interpretation of the maxima shown on the records of earthquakes during the surface wave phase The usual procedure is to treat the waves (which actually appear as beats) as being truly simple harmonic In general, this procedure does not necessarily lead to the correct interpretation In direct registration, the true earth maximum may have occurred one half-period later than the time obtained by the usual correction With galvanometric registration, the maximum may have occurred either one, two, or three half periods earlier than the time indicated by the usual formula due to Galitzin For direct registration, the phase correction at present in use appears to be as good as one of the alternatives For galvanometric registration, the correction suggested by

Somville, which is one half-period less than Galitzin's, should be adopted —H. E. Beckett The reflecting powers of rough surfaces at solar wave-lengths A hemispherical mirror was used for integrating diffusely reflected energy upon a thermopile receiver The paper deals at length with the errors inherent in the method and with the adjustment of the apparatus The theory of the method is simplified by the introduction of an auxiliary specimen which, in particular, renders the observations independent of the degree of blackness of the thermopile receiver

Institute of Metals (Annual General Meeting), Mar 11 —**W F Collins** The corrosion of early Chinese bronzes The patina and patination deposits formed by corrosion have resulted in the formation of definite minerals The Chinese bronzes contain an unusually high percentage of lead This preliminary research indicates that the bronze metallurgy of the early Chinese is distinct from that of the Sumerians —**C F Elam** An investigation of the microstructures of fifteen silver Greek coins (500–300 B C) and some forgeries All the genuine coins showed evidence of striking between dies, as opposed to the forgeries, which, with one exception, were made by casting only Analyses indicated that the coins were sometimes made from nearly pure silver, and sometimes copper was added The forgeries contained copper, and in two cases, zinc —**H J Gough** and **H L Cox** The mode of deformation of a single crystal of silver A single crystal of silver has been tested under alternating torsional stresses with the especial object of studying the formation of twin bands Throughout the tests, however, no definite twin markings were observed, although the surface of the specimen was covered by a complete system of slip bands in good agreement with the maximum resolved shear stress law The choice of silver as a suitable material for the study of the formation of twin bands under applied stress was made on the grounds that in the aggregate form silver is known to twin very readily —**C H M Jenkins** Some properties of metallic cadmium By maintaining cadmium cold during rolling, the material produced possesses properties markedly different from metal which is allowed to warm during this process In the short time tensile tests, worked material is stronger than cast material, but under prolonged stress the cast alloys are inferior to rolled samples Microscopic examination was also undertaken on the various materials produced The X ray examination of samples of hot and cold worked cadmium does not indicate an allotropic modification at room temperature and ordinary pressures, but there are marked differences in properties, which suggest a preferred orientation —**P J Durrant** The constitution of the cadmium rich alloys of the system cadmium-silver The constitution of the alloys of cadmium and silver from 0 to 40 per cent by weight of silver has been re investigated by the methods of thermal and micro graphic analysis The liquidus consists of four smooth curves which intersect with peritectic horizontals at 343°, 592°, and 640° C In the solid state the system gives rise to the following solid solutions (1) extending from 0 to 6 per cent by weight of silver, (2) extending from 18 to 33 5 per cent by weight of silver, (3) extending from 36 2 to 39 per cent by weight of silver —**D Stockdale** The solid solutions of the copper-silver system The mutual solubilities of copper and silver have been determined, chiefly by the method of examining quenched specimens under the microscope As this method fails at low temperatures, further information about the position of the phase boundaries was sought by measuring the electrical resistance of quenched wires A 'differential' method which shows up small, abrupt changes in the electrical resistance of alloys at the temperatures at which they occur is also described —**T P Hoar** and **R K Rowntree** A note on the silver rich aluminium-silver alloys above 600° C Aluminium of high purity and the combined use of thermal and micrographic analysis make possible certain modifications in the previously existing diagram

PARIS

Academy of Sciences, Feb 9 —**Molliard** The relations existing between the various organic acids elaborated by *Sterigmatocystis nigra* In cultures containing insufficient mineral salts, both gluconic and citric acids are formed as oxidation products of the sugars Both can serve as food material for the mould, but citric acid is not formed from gluconic acid —**Paul Marchal** Micropterism and seasonal dimorphism in *Trichogamma* —**André Blondel** The rationalisation of the electromagnetic equations —**M de Sparre** Concerning Foucault's pendulum Remarks on a communication of Charron —Armand de Gramont was elected a free academician in succession to the late Achille Le Bel —**A Buhl** Conoidal propagations in wave geometry Waves derived from the ellipsoid —**Jean Capoulade** Green's harmonic function of a domain of revolution —**Jean Pierre Robert** Mediation and metaharmonic functions —**Georges Calugaréano** A generalisation of Borel's theorem on meromorph functions —**L Tchakaloff** The interval of variability of ξ in the formula

$$\int_a^b p(x)\phi(x)dx = \phi(\xi)\int_a^b p(x)dx$$

—**F E Myard** The realisation of mechanisms with pure rolling **Paul Le Rolland** A resonance method for measuring rigidity and testing the stability of a construction —**E Brylinski** A new system of units Discussion of a recent communication by A Blondel on the same subject —**Vernotte** The impossibility of assuring at any moment a sufficient and known thermal isolation with a solid insulating material The loss through the insulating material is only relatively small when the steady state is attained At any given moment, the loss depends not only on the temperatures, but also on the variation of these temperatures with the time —**L Dubar** Rectifying elements with copper oxide By micrographic analysis, Pélabon has shown that the oxide layer of a copper oxide rectifier is essentially non homogeneous and consists of a relatively thick and semi conducting layer of cuprous oxide holding some cupric oxide in suspension, this layer being separated from the copper by a very thin semi insulating skin of nearly pure cuprous oxide The electrical properties of these layers have been studied separately, and the results are in agreement with Pélabon's hypothesis —**Th V Jonescu** and **C Mihul** The dielectric constant and the conductivity of ionised gases —**Jean Louis Destouches** The capture of electrons by positive ions Contrary to the views expressed by Rutherford, the results obtained show that the phenomenon of capture of electrons is the same whatever may be the relative velocity of the ions and electrons —**J Peltier** The exploration of ferromagnetic bodies of revolution by the use of rotating fields —**J Gilles** The dispersion of internal energy at the quadruple and triple terms $3sP$, $3pP$, $3pD$, in the spectra of the elements carbon, nitrogen, oxygen, and fluorine at different degrees of ionisation —**Pauthenier** and **Bart** The double refraction of safrol Safrol, whether of commercial quality or carefully purified, shows no residual double refraction in either constant or alternating fields This is not in agreement with the results of Leiser —**Desmaroux** and **Mathieu** Remarks on the structure

of nitrocellulose Discussion of the results of X ray studies of nitrocellulose —**Mlle O Hun** Contribution to the ebullioscopic study of the complexes formed by the cadmium halides and the corresponding alkaline halides —**Augustin Boutaric and Jean Bouchard** The influence of light on colloidal solutions in fluorescent media The rôle of antioxygens —**Maurice Auméras** The specific heats of solutions of sodium sulphate —**N Slomnesco** The decomposition of carborundum by a mixture of nitric and hydro fluoric acids —**P Cordier** The dibenzylsuccinic acids —**A Mavrodin** The action of ethylmagnesium halides on ethyl diethylcyanacetate —**V Hasenfratz** Nativelle s digitaline and digitoxin —**Jean Lacoste** Stratigraphical notes on the southern Rif (Moulay Bou Chta region) **Bogdan Varitchak** Remarks on the distribution of the cytome at the moment of zoo spore formation —**L Margaillan** The oil of *Wrightia annamensis* an oil resembling castor oil This oil strongly resembles castor oil in physical and chemical properties there is one point of difference the *Wrightia* oil is much more soluble in light petroleum ether —**J Millot** The comparative anatomy of the middle cephalo thoracic intestine in the true spiders —**A B Chauchard and S Kajiwara** The relation of the chronaxies of antagonists in narcosis produced by compression of the brain **Georges Bourguignon and Socrate Eliopoulos** The action of iodine calcium and magnesium ions on the oscillometric index and the arterial pressure in trans cerebral dielectrolysis —**R Marcille** An apparatus affording protection against toxic gases —**Charles Richet** Remarks on the pre ceding communication

WASHINGTON, D C

National Academy of Sciences (*Proc* Vol 16 No 11 Nov 15) **William Hovgaard** (1) The stress distri bution in welds By a process of integration and variation which presupposes continuity an expression valid within the limit of elasticity is obtained for the stress distribution in the case of a bar connected to another structural member subject to simple tension or compression —(2) The stress distribution in welded overlapped joints —**H Diamond and F W Dunmore** A radio system for blind landing of aircraft in fog (see NATURE Feb 14 p 252) —**Theodore Theodorsen** A sensitive induction balance for the purpose of detect ing unexploded bombs A power coil produces a field and the fluxes through two pick up coils are compared The field is considered to consist of the undisturbed power field and the superimposed field induced in the hidden object the latter is detected by the pick up system A small 500 cycle generator is used —**Frederick D Rossini** The heat of formation of water The calorimeter was surrounded by a constant tem perature jacket and contained a measured quantity of water a temperature measuring device, stirring mechanism and a reaction vessel for burning the gases at constant pressure, and a heating coil The thermal energy liberated by combustion of oxygen and hydrogen to form a measured mass of water is compared with that liberated by a measured quantity of electrical energy Thus the results depend on the determination of a mass of water formed and a quantity of electrical energy passed The heat of formation of one mole (18 0156 gm) of liquid water found is 285 890 ± 40 absolute joules or 68,313 ± 10 gm cal (15°) —**Horace S Isbell** (1) Crystalline alpha and beta methyl-*d* gulosides —(2) The ring structure of mannose —**M Demerec and J G Farrow** (1) Non disjunction in the *X* chromosome in *Droso phila virilis* —(2) Relation between the X ray dosage and the frequency of primary non disjunctions of *X* chromosomes in *Drosophila virilis* Primary non disjunction increases with X-ray dosage at first, but falls off eventually, when the fertility of treated flies also declines —**L J Stadler** Recovery following genetic deficiency in maize Recovery of an 'inactive' gene has been observed equally in X rayed and untreated material —**Walter M Nielsen** Magnetic analysis of negative ions in mercury vapour Electrons from a tungsten filament are projected parallel to a magnetic field of 100 gauss, mercury vapour passes up the discharge space and ions are produced by a beam of electrons Positive or negative ions are 'pulled out' by an accelerating potential and analysed magneti cally Evidence was found of negative ions at pres sures of the order of 10^{-4} mm of mercury —**Hugh L Dryden and George C Hill** The pressure of the wind on large chimneys An experimental chimney stack, 10 ft in diameter and 30 ft high, was erected on the roof of one of the U S Bureau of Standards buildings and wind pressures measured at twenty four stations round the circumference at a single elevation about two thirds of the height from the base Arrangements have been made for similar observations on a new chimney at the Bureau Wind pressure on a chimney is a function of the ratio of height to diameter of chimney and possibly of surface roughness It may reach large values locally, but 20 lb per square foot of projected area at a wind speed of 100 miles an hour is generally a safe value Experiments on small cylinders cannot be used to predict wind pressure on account of the large scale effect —**L P Eisenhart** Projective normal co ordinates —**H S Vandiver** (1) On the norm residue symbol in the theory of cyclo tomic fields —(2) On the second factor of the class number of a cyclotomic field —**E T Bell** Periodic recurring series **H F Bohnenblust** Note on singu larities of power series —**J H C Whitehead** A method of obtaining normal representations for a pro jective connexion —**Tracey Yerkes Thomas** On the unified field theory (1) Einstein s theory introduces the possibility of distant parallelism into the scheme of Riemannian geometry in each point of the under lying continuum of space and time there is a local Cartesian co ordinate system in which the Pythagori can theorem is satisfied These systems are determined by four independent vector fields Subject to certain conditions a system of sixteen wave equations is constructed to represent the combined gravitational and electromagnetic field **Marston Morse** The critical points of a function of *n* variables

Official Publications Received.

BRITISH

Geological Survey Department Tanganyika Territory Short Paper No 6 A Note on the Geology of the Country around Tendagaru Lindi District By Dr John Parkinson Pp 16+7 plates (Dar es Salaam) 2s.

Canada Department of Mines Geological Survey Memoir 163 Geology of Southern Alberta and Southwestern Saskatchewan By M Y Williams and W S Dyer (No 2244) Pp iii+160+8 plates Summary Report 1928 Part C (No 2218) Pp 115 Summary Report 1929 Part A (No 2251) Pp 319 Summary Report 1929 Part C (No 22 0) Pp 60 Economic Geology Series No 8 Zinc and Lead Deposits of Canada By F J Alcock (No 2229) Pp vii+406+8 plates 75 cents (Ottawa F A Acland)

Department of Agriculture Straits Settlements and Federated Malay States Scientific Series No 4 The Bionomics and Control of *Leptocorisa acuta* Thunb with Notes on other *Leptocorisa* spp. By G H Corbett Pp ii+40+7 plates (Kuala Lumpur) 1 dollar

Southern Rhodesia Geological Survey Bulletin No 17 The Geology of the Country between Gatooma and Battlefields By A M Macgregor Pp 144+15 plates (Salisbury) 4s 9d

Department of Health for Scotland First Report of the Scottish Advisory Committee on Rivers Pollution Prevention 1 Summary of the Law relating to Rivers Pollution Prevention 2: The River Tweed and its Tributaries Pp 68 (Edinburgh and London H M Stationery Office) 1s net

Proceedings of the Society for Psychical Research Part 117 Vol 39 February Pp 347 378 (London) 2s. 6d

South Australia Annual Report of the Director of Mines and Government Geologist for 1929 Pp 8 (Adelaide Harrison Weir)

British Science Guild. A Report on the Scientific and Professional Staffs in the Public Services and Industry Prepared by the Committee on the Position of the Technical Expert in the Public Services and Industry Pp vi+62 (London.) 1s.

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 69, No 410, February Pp 213-324+xxx. (London E and F N Spon, Ltd) 10s. 6d

Department of Health for Scotland Milk Consumption and the Growth of School Children Report of an Investigation in Lanarkshire Schools By Dr Gerald Leighton and Dr Peter L McKinlay Pp 20 (Edinburgh and London H.M Stationery Office) 3d net.

London, 1930. IX International Horticultural Congress by the Invitation of the Royal Horticultural Society and under the Auspices of the International Committee for Horticultural Congresses, August 7th to 15th Report and Proceedings Pp. 450 (London) 15s

Proceedings of the Linnean Society of London 142nd Session, from November 1929 to May 1930 Pp. iv+252 10s Session 1930 31 Part 1 Pp. 16. 6d. (London)

The Transmutation of the Chemist. (The Second S. M Gluckstein Memorial Lecture 1930.) By Dr A E Dunstan Pp. 22 (London The Institute of Chemistry)

Proceedings of the Edinburgh Mathematical Society Series 2, Vol 2 Part 3, January Edited by Prof H W Turnbull and Dr E T Copson Pp 129 180 (London G Bell and Sons, Ltd)

Journal of the Royal Statistical Society Vol 94, Part 1 Pp 172+xiii (London) 7s 6d

Seale Hayne Agricultural College, Newton Abbot, Devon Pamphlet No 35 Clotted Cream By W B V Tresidder Pp 16 (Newton Abbot.)

Records of the Albany Museum Vol 4, Part 1, January 9th Pp 168+17 plates (Grahamstown) 12s 6d

British Scientific Instruments in Industry Pp 48 (London British Optical Instrument Manufacturers Association, Ltd)

Department of Scientific and Industrial Research Building Science Abstracts Vol 4 (New Series), No 1, January Abstracts Nos 1 214 Pp iii+88 (London H M Stationery Office) 9d net.

Department of Scientific and Industrial Research The Investigation of Atmospheric Pollution Report on Observations in the Year ended 31st March 1930 Sixteenth Report Pp vii+74 (London H M Stationery Office) 4s net.

City and County of Bristol Bristol Museum and Art Gallery Report of the Museum and Art Gallery Committee for the Year ending 30th September 1930 Pp 28+5 plates (Bristol) 2d

Transactions and Proceedings of the New Zealand Institute Vol 61 Parts 3 4 November 1930 Pp iii+441 566+plates 68 91 (Wellington)

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1341 (Ae 478—T 2971) The Motions, at the Stall, of a Bristol Fighter Aeroplane with Slot and Aileron Control on both Planes By K W Clark Pp 7+6 plates. 9d net No 1352 (Ae 483—T 2983) Movement of Smoke in the Boundary Layer of an Aerofoil without and with Slot By T Tanner Pp 2+8 plates 1s net No 1348 (Ae 475—T 2995) The Automatic Timing of Aircraft over a Speed Course By J K Hardy and K V Wright, with an Appendix by S B Gates Pp 9+9 plates 1s net. No 1354 (Ae 485—T 2810) Lift and Drag of Blackburn 'Iris By L P Coombes and R K Cushing Pp 5+4 plates 6d net (London H M Stationery Office)

University of London University College Report of the University College Committee (February 1930-February 1931) with Financial Statements (for the Session 1929-30), and other Documents for Presentation to the Court and the Senate Pp 130. (London Taylor and Francis)

Empire Cotton Growing Corporation Reports received from Experiment Stations, 1929-1930 Pp xi+342 (London) 2s 6d

Proceedings of the Royal Society Series A Vol 130, No A814, February 3 Pp. 481 551 6s Series B, Vol 107 No B753, February 3 Pp 417 510 6s (London Harrison and Sons, Ltd)

The South Eastern Naturalist and Antiquary being the Thirty fifth Volume of Transactions of the South Eastern Union of Scientific Societies, including the Proceedings at the Thirty fifth Annual Congress, held at Portsmouth, 1930 Edited by A F Ravenshear Pp lxv+131 (London) 5s. net

Memoirs of the Geological Survey of India Vol 58 The Gondwana System and related Formations (Coal in India, 2) By Dr Cyril S Fox Pp v+241+10 plates. (Calcutta Government of India Central Publication Branch) 6 rupees 9s. 9d

Department of Scientific and Industrial Research Report for the Year 1929-30 (Cmd 3789) Pp 224 (London H M Stationery Office) 3s 6d net

Journal of the Indian Institute of Science Vol 13A, Part 13 Amylase from Wheat By Dattatreya Vishnu Karmarkar and Vinayak Narayan Patwardhan Pp 159 164 12 annas Vol 13A, Part 14 Biological Oxidation of Sulphur Part 4 Influence on Ammonification and Nitrification in Activated Sludge. By C V Ramaswami Ayyar Pp 165 171 1 rupee (Bangalore.)

Indian Journal of Physics Vol 5, Part 7, and Proceedings of the Indian Association for the Cultivation of Science, Vol 14, Part 7 Conducted by Sir C. V Raman. Pp. 609-767+ix (Calcutta) 1 8 rupees, 2s.

Journal of the Chemical Society February Pp. iv+221-444+vi Supplementary Number, containing Title-Pages, Contents and Indexes, 1930. Pp 2703 3900+4+xxxii (London)

Economic Advisory Council Committee on the Mineral Content of Natural Pastures. Sixth Report. Pp 66. (London H M Stationery Office) 1s. net.

FOREIGN

Album of Abyssinian Birds and Mammals. From Paintings by Louis Agassiz Fuertes. (Special Publication of Field Museum of Natural History) Pp. iv+32 plates. (Chicago Field Museum of Natural History) 3 dollars.

Abridged Scientific Publications from the Kodak Research Laboratories Vol 13, 1929 Pp. 271+vii. (Rochester, N Y Eastman Kodak Co)

Journal of the Federated Malay States Museums. Vol 16, Parts 1 and 2, December Pp. 174. (Kuala Lumpur)

Field Museum of Natural History Anthropology Memoirs, Vol 2, No 2 Archaeological Explorations in Peru Part 2 The Northern Coast. By Prof A. L. Kroeber (First Marshall Field Archaeological Expedition to Peru.) Pp 45 116+plates 14-31 Botanical Series, Vol 8, No 3 Studies of American Plants IV By Paul C Standley (Publication 281) Pp 131 236. Zoological Series, Vol 17, No 7 Birds of the Marshall Field Peruvian Expedition, 1922-1923 By John T Zimmer (Publication 282) Pp 231 480 (Chicago)

Société des Nations Institut International de Coopération Intellectuelle (League of Nations International Institute of Intellectual Cooperation). Code International d Abbréviations des Titres de Périodiques. Élaboré par un sous Comité sous les auspices de l Institut International de Coopération Intellectuelle. (International Code of Abbreviations for Titles of Periodicals Drawn up by a sub-Committee under the auspices of the International Institute of Intellectual Cooperation) Pp 12 (Paris.) 2 50 francs

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 98 A Summary of Rice Breeding Work, 1921-29 By G P Morris and Mohammad Eff el Dib Pp 15+7 plates 5 P T Bulletin No 102 A Concise Account of Barley Breeding, 1921-1929 By G P Morris and M A Kosheiry Eff Pp 19+4 plates 5 P T (Cairo Government Press)

Acta Phytochimica. Edited by Prof Keita Shibata Vol 5, No 2 December Pp 99 211 (Tokyo The Iwata Institute of Plant Biochemistry) 2.00 yen

Ministry of Public Works Egypt Physical Department Meteorological Report for the Year 1924. Pp xiii+174 (Cairo Government Press) 40 P T

Sudan Notes and Records Vol 13, 1930 Part 2 Pp iv+149 294+20 plates (Khartoum) 30 P T , 6s

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 111 Jahresversammlung vom 11 bis 14 September 1930 in St Gallen Pp 500+60+8 Tafeln (Aarau H R Sauerlander und Co)

Anuario del Observatorio Astronómico de Madrid para 1931 Pp 476 (Madrid Instituto Geográfico y Catastral)

Pubblicazioni della R. Università degli Studi di Firenze Fascicolo N 47 Osservazioni e Memorie del R Osservatorio Astrofisico di Arcetri Pp. 56 (Firenze)

Scientific Publications of the Cleveland Museum of Natural History Vol 1 No 4 Notes on a Collection of Birds from Arizona and New Mexico By Harry C Oberholser Pp 83 124+plate 18 (Cleveland, Ohio)

Scientific Papers of the Institute of Physical and Chemical Research Nos 278 281 On the Hydrosol of Silicic Acid, 1 Hydrosol made from Ethyl Silicate by Hydrolysis by Kenkyo Inaba On the Hydrosol of Silicic Acid 2 On the Electrical Properties of the Hydrosol of Silicic Acid, by Kenkyo Inaba On the Relation of Vitamins to Carcinogenesis, by Waro Nakahara Some Remarks on the Angular Intensity Distribution of Continuous X Ray Spectrum III by Yoshikatsu Sugiura Pp 59 65 sen No 282 Spectrum of Singly Ionized Chlorine (Cl II) By Kiyoshi Murakawa Pp 41 67 40 sen Supplement No 12 Effect of adding Colloids to the Electrolytic Solutions for preparing the Anodic Film on Aluminium By Shoji Setoh and Akira Miyata Pp 6 10 sen (Tōkyō Iwanami Shoten)

U S Department of Agriculture Farmers Bulletin No 1638 Rat Proofing Buildings and Premises. By James Silver W E Crouch and M C Betts Pp ii+26 5 cents Technical Bulletin No 206 Ecological Studies of the Beet Leaf Hopper By Walter Carter Pp 115+8 plates 30 cents (Washington, D C Government Printing Office)

Bulletin, Technical Series, Vol 11 No 3 Laboratory Concentration of the Missouri Iron Ores of Iron Mountain and Pilot Knob By F D DeVaney and S R B Cooke Pp 38 (Rolla, Mo School of Mines and Metallurgy)

Smithsonian Miscellaneous Collections Vol 73, No 7 Opinions rendered by the International Commission on Zoological Nomenclature Opinions 115 to 123 (Publication 3072) Pp 36 (Washington, D C Smithsonian Institution)

Annual Report of the Naval Observatory for the Fiscal Year 1930. Pp. 22 (Washington, D C Government Printing Office)

Cornell University Agricultural Experiment Station Bulletin 510 Growing Onions on the Muck Soils of New York By J E Knott. Pp 34 Bulletin 511 The Collection of Taxes by the State of New York, and the Division of these Revenues with Units of Local Government. By M Slade Kendrick Pp. 53 Bulletin 512 The Money Income of Farm Boys in a Southern New York Dairy Region By Howard Wayland Beers Pp 55 Memoir 133 The Effect of Spiral Ringing on Solute Translocation and the Structure of the Regenerated Tissues of the Apple By L H Macdaniels and Otis F Curtis Pp 31+5 plates (Ithaca, N Y)

Carnegie Institution of Washington Year Book No 29 July 1 1929, to June 30, 1930, with Administrative Reports through December 12, 1930 Pp xix+454 (Washington, D C Carnegie Institution)

Proceedings of the American Academy of Arts and Sciences Vol 66, No 1 A Report on the Coastal Waters of Labrador based on Explorations of the *Chance* during the Summer of 1926 By C Iselin Pp 37 75 cents Vol 66, No 2 The New World Species of the Genus Solenopsis (Hymenop Formicidae). By William S. Creighton Pp. 39 151+8 plates 2 dollars Vol 66, No 3 Equations for Vapor Pressures and Latent Heats, including Approximate Equations for Solid Compounds containing a Gaseous Component By Louis J Gillespie Pp 153 165 45 cents Vol 66, No 4 An Experimental Study of the Absolute Temperature Scale 1 The Construction of several Types of Platinum Resistance Thermometers. By James A Beattie, David D Jacobus and John M Gaines, Jr Pp 167 184 45 cents (Boston, Mass)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University Vol 8, Part 4, December Pp 377 458. (Tōkyō Iwanami Shoten) 95 sen

Records of Oceanographic Works in Japan Vol 2, No 2, December 1930. Pp 57 110+plates 6-10 Vol 3, No. 1, December 1930 Pp 34. Tokyo National Research Council of Japan)

Japanese Journal of Mathematics Transactions and Abstracts, Vol 7, No 3. Pp. 199 266. (Tokyo National Research Council of Japan)

U S Department of Commerce Bureau of Standards Miscellaneous Publication No. 117 Units used to Express the Wave Lengths of Electro magnetic Waves. By Henry D Hubbard Pp 4 5 cents Research Paper No 252 Precision of Color Temperature Measurements under various Observing Conditions A New Color Comparator for Incandescent Lamps By Deane B Judd Pp 1161 1177 10 cents Research Paper No 258 The Freezing Point of Nickel as a Fixed Point on the International Temperature Scale By H T Wensel and W F Roeser Pp 1309 1318 5 cents (Washington, D C Government Printing Office.)

CATALOGUES

Sanusin Scmpules and Sanusin Pessaries Pp 4 Radio Malt Pp 4 (London The British Drug Houses Ltd)

Periodica the Cannon House Catalogue of Journals of all the Sciences. (N S No 4) Pp 74 (London Wm Dawson and Sons Ltd)

Catalogue of Books on Chemistry and Chemical Technology Pp 52 (London H K Lewis and Co, Ltd)

The Nickel Bulletin Vol 4 No 3, March Pp 65 92 (London The Mond Nickel Co, Ltd)

Diary of Societies.

FRIDAY, MARCH 27

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (at Middlesex Guildhall, Westminster), at 3 —Annual Meeting

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub Centre) (at Electricity Offices, Swansea) at 6

INSTITUTION OF STRUCTURAL ENGINEERS (at Chamber of Commerce, Birmingham), at 6 30 – Annual General Meeting

INSTITUTE OF FUEL (East Midlands Section) (at Technical College, Derby), at 7 —P H N Ulander The Power Consumption of Boiler house Auxiliaries

MANCHESTER ASSOCIATION OF ENGINEERS (Annual General Meeting) (at Engineers Club, Manchester), at 7 —C Longden Developments in Modern Foundry Practice

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) at 7

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 — Exhibition of Industrial Kinematograph Films

JUNIOR INSTITUTION OF ENGINEERS (at County Hotel, Newcastle on Tyne), at 7 15 —L Clegg Synthetic Resin Products

INSTITUTE OF BRITISH FOUNDRYMEN (Birmingham, Coventry and West Midlands Branch) (at Chamber of Commerce Birmingham), at 7 30 — T G Bamford The Melting of Cast Iron

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —C E Prince Light Sensitive Work in Modern Industry

GEOLOGISTS ASSOCIATION (in Architectural Theatre University College) at 7 30 Prof I S Palmer On the Pleistocene Succession of the Bristol District —E M Venables Notes on the Geology of Felpham, near Bognor Regis

MICROSCOPICAL SOCIETY OF WALES (at Cardiff Technical College), at 7 30 —Dr P Morgan The Microscope in Bacteriological Work

INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers Technical College, Bristol), at 7 30 —W E Francis Testing of Materials.

JUNIOR INSTITUTION OF ENGINEERS (at Metallurgical Club, Sheffield), at 7 30 —J F Webster Notes on Recent Road Transport Legislation

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8 Dr A F MacCallan Trachoma Its Importance as a World wide Disease

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Lord Rutherford Helium and its Properties

SATURDAY, MARCH 28

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Lord Rutherford Recent Researches on the Alpha Rays (4).

INSTITUTE OF BRITISH FOUNDRYMEN (East Midlands Branch) (at Loughborough College), at 6 —Dr A. B Everest Recent Developments in Special Cast Iron

INSTITUTE OF BRITISH FOUNDRYMEN (Newcastle-on Tyne and District Branch) (at Neville Hall Newcastle-on Tyne), at 6 15.—The Brackiesberg Process for Production of Grey Cast Iron.

MONDAY, MARCH 30

INSTITUTE OF ACTUARIES, at 5 —J B Maclean Notes on the Practical Application of the Contribution Method of Distributing Surplus — W Pollock Variations under Altered Conditions in the Bonus Provided by a Given Scale of Premiums.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —H Astbury and others Discussion on The Rupturing Capacity of E H T and L T Switchgear to be installed on Consumers' Premises

INSTITUTION OF LOCOMOTIVE ENGINEERS (at Chamber of Commerce Birmingham) at 7 —H Chambers Improvements in Water Pick up Gear for Locomotives

HUNTERIAN SOCIETY OF LONDON at 7 15 —Dr E P Poulton and Dr O Heath Discussion on The Common Cold

TUESDAY, MARCH 31

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 6 15 —Annual General Meeting and Induction of New President, J Kewley

ROYAL AERONAUTICAL SOCIETY (jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 6 30 —High Speed Heavy Oil Engines

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group) (Annual General Meeting), at 7 —S. O Rawling: Examination of the Newman Exposure Apparatus —A S Newman A New Design of Microscope

SHEFFIELD METALLURGICAL ASSOCIATION (at Sheffield), at 7 30.—Dr S W Fell Gases in Steel (with special reference to Oxygen).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Diesel Engine Users Association, Institute of Fuel, Institute of Marine Engineers, Institution of Automobile Engineers, Institution of Engineers in Charge, Institution of Mechanical Engineers, Institution of Petroleum Technologists, Junior Institution of Engineers, Royal Aeronautical Society, and Society of Engineers) (at Institution of Mechanical Engineers), at 7 45 —Dr S J Davies and E Giffen Injection, Ignition, and Combustion in High Speed Heavy Oil Engines

WEDNESDAY, APRIL 1

GEOLOGICAL SOCIETY OF LONDON, at 5 30

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) at 6 —R Naismith (a) Short Distance Observations on Long Wave Phenomena, (b) Field Strength Measurements on Daventry 5XX

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle upon Tyne), at 7 15 — Debate

SOCIETY OF GLASS TECHNOLOGY (London Section) (at National Physical Laboratory, Teddington), at 7 30

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8 —R. C Frederick Carbon Monoxide Poisoning Its Detection and the Determination of the Percentage Saturation in Blood by means of the Hartridge Reversion Spectroscope.— H M Mason and G Walsh Experiments on the Hardness of Fats.— Dr B S Evans A New Process for the Determination of Small Amounts of Bromide in Chloride.—S G Walton and R G O Brien The Use of Bromine as a Reagent in the Determination of Alkaloids

ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B M A House, Tavistock Square).

PUBLIC LECTURE.

SATURDAY, MARCH 28.

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Prof J R Ainsworth Davies Fur bearing Animals in Canada.

CONFERENCE.

SATURDAY AND MONDAY, MARCH 28 AND 30

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Edinburgh).

Saturday, March 28 (in Department of Zoology)

10 A M to 1 P M —J Hammond The Life of the Unfertilised Ovum.

A J M Smith The Problem of the Vitelline Membrane (a) Gas Exchange and Osmotic Equilibria of the Infertile Hen s Egg

J Needham M Stephenson, and D M Needham The Problem of the Vitelline Membrane (b) Lactic Acid Production in the Infertile Hen s Egg

J Needham The Problem of the Vitelline Membrane (c) The Osmotic Properties of the Isolated Membrane

H O Bull Conditioned Responses and Salmon Smolts

W H Pearsall and M Pilling The Physiology of Storage in the Apple

E C Barton Wright The First Sugar of Photosynthesis

(In Department of Animal Genetics)

2.15 to 3 45 —F A E Crew and L Mirskaia (a) Genetic and Physiological Studies on the Hairless Mouse (b) Observations on the Aged Male and Female Mouse

B P Wiesner, P G Marshall, J M Robson H Taylor, and R E Illingworth Recent Experiments on the Dynamics of the Sex Cycle.

3 45 to 5 30 —Demonstrations

5 30 to 6 30 —E Boyd Experiments on Skin Transplantation in the Mouse

E M Gilroy The Effect of Arginine and Thyroxine on the Growth Rate of a Transplantable Tumour of the Mouse

Monday, March 30 (in Department of Bacteriology)

10 A M to 12 15 P M —I J Blake Experimental Infection of *Salmo fario* by *Bacillus salmonicida*

A Cunningham and T Gibson Recent Work on the Filterable Gonidial Stages of Bacteria.

T J Mackie M H Finkelstein and H J Gibson The Natural Antibodies of Various Animal Species.

J M Alston Analysis of Antigens on the Basis of Chemistry and Function

M H Christison Microbic Dissociation with Special Reference to the Tubercle Bacillus

12 15 to 1 —Demonstrations

(In Department of Zoology)

2 15 to 3 45 —A Walton Gas Storage of Mammalian Spermatozoa

A L Craig Bennett Observations on the Influence of Temperature on the Breeding of Animals

A Graham Temperature and *p*H Optima of Invertebrate Enzymes.

3 45 to 4 30.—Demonstrations

4 30 to 6 —J W Gregor Experimental Methods in Taxonomy

V E McM Davey Inheritance of Colour in Certain Species of *Brassica*.

W Black Inheritance of Colour in the Potato Tuber

ANNUAL MEETING.

INSTITUTION OF NAVAL ARCHITECTS (at Royal Society of Arts).

Friday, March 27, at 10 30 A M —Dr H H Blache The Present Position of the Diesel Engine for Marine Purposes.

H E Yarrow Water Tube Boilers in Some Recent Merchant Ships with Service Results.

W H Howden Some Modern Examples of Air Heaters

At 3 30 —E F Spanner Beam Frame Connexions.

SATURDAY, APRIL 4, 1931.

CONTENTS

Editorial and Publishing Offices

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No. 3205, Vol. 127]

Birth Control and Human Biology

FEW subjects are of greater social significance, or have aroused more violent opposition in recent years, than that of birth control Since Dr Marie Stopes started her energetic campaign ten years ago, she has had to contend with much misrepresentation, together with calumny from certain ecclesiastical quarters It is gratifying to know, therefore, that on Mar 17 a large and distinguished company assembled at the Ritz Hotel to congratulate her upon the success of her pioneer work for the benefit of the human race through the positive control of conception A further indication of the growth of public opinion on the subject of birth control is given by the recent announcement from the Ministry of Health that contraceptive advice may be given in clinics controlled by local authorities, when it is desirable in the interests of health

The society founded by Dr Stopes has the title " Constructive Birth Control " and she rightly insists on the word " constructive " By this Dr Stopes means that her aim is not only to prevent children being born to poor and unhealthy parents, but also to bring the joys of parenthood to sterile couples who desire children and have the means to support them This part of the work of " Constructive Birth Control " must, however, always constitute a very small proportion of the whole, by far the greatest task is that of preventing undesirable births

Now, the means of preventing births—leaving out the illegal and dangerous method of abortion—resolve themselves in two categories, namely (1) prevention of the dehiscence of the eggs, and (2) immobilisation or destruction of the spermatozoa Until recent years methods of the latter kind only have been adopted, and to many people these methods seem disgusting and destructive of all the romance of sexual congress We are, however, coming in sight of much simpler and unobjectionable methods, there is hope of being able to prevent by means of the injection of an extract of pituitary gland the dehiscence of the eggs altogether This injection can be made anywhere on the body, and its effect will last for a whole menstrual period

It is obvious that if the efficacy of the new method referred to can be confirmed and its mode of application standardised, sentimental objections to birth control will disappear there will remain only the ' moral ' and ecclesiastical ones, and on the ecclesiastical objections a word or two

may be said in the interests of clear thinking and accurate history Whatever weight there may be in these objections, they derive no support whatever from the recorded sayings of the Founder of Christianity or from those writings of His great apostle Paul which are most widely accepted as genuine For, from the sayings of Jesus and the writings of Paul, it is clear that both held the view that the present order of Nature would be terminated after a brief period of about forty or fifty years and be replaced by a supernatural order miraculously introduced from heaven, which would establish the "kingdom of God", in which there would be "neither marrying nor giving in marriage" In the meantime, marriage was legal as a concession to the flesh but it was futile and "it remaineth that those with wives should be as those that had none" With an outlook on life and the future of the world so totally different from our modern one, the question of the necessity of birth control could never have presented itself to early spiritual teachers

Dr Stopes was led to advocate birth control from observation of the misery, pain, and disease caused by the overbreeding of the poor Many ladies of great refinement and initial prejudice against birth control have been driven to the same conclusion as Dr Stopes, from the same cause In her book, "The First 5000", Dr Stopes has given heartbreaking accounts of women looking like old hags at the age of thirty five, never free from pain, having forgotten what normal good health means, who, when examined in her clinic, have been discovered to be suffering from displaced wombs, lacerated cervices, and other injuries Such women frequently had histories of annual confinements often resulting in still births, and indeed, from the condition of the womb, it was difficult to see how any other result was to be expected

It has been objected that only unhealthy women would visit the clinic, and that the great majority of working class mothers remain healthy and strong in spite of having had large families in fact, it has been contended that in a normal woman, child bearing, instead of injuring, actually promotes health It may be that Dr Stopes has drawn too dark a picture, but it must be remembered that Dr Jansen- a leading Dutch authority on maternity and heredity—in a book entitled "Feebleness of Growth", comes to the conclusion that, in cases where the influences of alcohol and of venereal disease could be excluded, the members of large families showed a progressive deterioration in size and strength as births succeeded one another This deterioration was not due to any inherent differences in the germs, for when, as in some cases, one or two children died in early infancy, the next surviving child was actually stronger than the last one, showing that the real cause of the deterioration was the exhaustion of the mother But, however important these humanitarian considerations may be, and however much all kindly disposed persons must sympathise with Dr Stopes in her fight against misery and pain in her own sex, there are biological arguments in favour of birth control which enormously outweigh the philanthropic ones and in our opinion erect the question of birth control into the most urgent and important problem of modern times

Dr Elton, in his charming text book on "Animal Ecology", puts the problem most clearly by pointing out that if the numbers of a species are to remain constant, the number of offspring which survive their parents must not exceed two But every known species produces far more offspring than this Suppose now the conditions of the environment to become temporarily more favourable and that three children survive each pair of parents This would mean an increase in the population of 50 per cent in one generation If we represent the original population as 100 and the same increase continued for another generation, the population would increase by 50 per cent over 150 that is, it would reach the figure of 225 and be more than doubled in three generations It is easily seen that in these circumstances the numbers of the species would rapidly attain the dimensions of a plague, and, as Dr Elton shows, at this point a mad impulse to migration sweeps over it, and in rapidly breeding animals like rodents these crises tend to occur at intervals of ten to eleven years

Dr Uvarov has proved that the devastating swarms of migratory locusts develop at intervals out of populations of apparently harmless grasshoppers when owing to the climate in some particular year an unusually large number of eggs hatch out The same thing has been observed in fish After the method had been elaborated of determining the age of fish by counting the rings of growth on their scales, the surprising discovery was made that the herring hatched in a particular year had constituted the bulk of the catch for a long period of years When the matter was inquired into, it was found that the number of eggs spawned in that particular year was not greater than normal, but that owing to the coincidence of the spawning and of a particularly abundant crop of diatoms, far more herrings than usual had survived their

babyhood, so that what had increased was not the *birth rate* but the *survival-rate*

Now, all these phenomena, namely, an increase in survival rate, the consequent abnormal increase in population, and mass migration, have occurred time and again in the human race They are consistently ignored because, man being a slower breeder than most animals, they occur at long intervals and several generations may elapse without their making themselves felt During Classical and Middle Ages there were breeding grounds of hardy, virile races from which swarms of young men issued forth to plunder their civilised neighbours Sometimes these swarms developed into mass migrations, bringing women and children with them Such breeding grounds were the lands surrounding the Baltic the peninsula of Arabia, and the steppes of central Asia Quite obviously, all three regions were incapable of supporting an increasing population, and when the alternatives starvation or migration were presented to them, the sturdy inhabitants invariably chose the latter Nothing more terrible than the Tartar invasions of Mesopotamia, Syria, and Egypt has occurred during human history It may be argued that with the perfection of modern weapons and modern transport such dangers have become things of the past That is partly true, civilised countries are no longer likely to be overrun by hordes of hungry barbarians But the cause of these invasions, the tension of an ever-increasing population, continues to operate and will certainly produce disturbances almost equally as formidable as the Tartar invasions

If we take our own country, we find that in 1600 the population of England and Wales was about 5,000,000, in 1700 it was 5½ million, in 1800 it was 9,000,000, and in 1900 it was more than 30,000,000 The enormous increase in the nineteenth century is usually ascribed to the 'industrial revolution' that is, the introduction of machinery driven by steam for manufacture This, it is argued, provided far more openings for employment, and consequently the poor produced more children But Miss Buer ("Health, Wealth, and Population—the Early Days of the Industrial Revolution") shows that this is a mistaken deduction The increase in population began before the 'revolution' the birth-rate did not increase to any marked extent, but the *survival-rate* increased owing to the introduction of vaccination, modern sanitation, and a purer water supply From 1880 onwards, the birth-rate began to fall, owing to the introduction of birth control methods amongst the well-to-do, but until the present day it remains undiminished amongst the lowest and least skilled section of the population By our grandmotherly system of doles, maternity benefit, etc, we are doing our best to encourage it Forty years ago, this section of the population bred as it does now, but the great majority of the children died To-day, however stupid, they survive and constitute an increasing proportion of the future nation

Before the War, the increase in population was to a considerable extent relieved by emigration to the Dominions and the United States To-day that door is closed, the United States will admit annually only a small quota, and the Dominions, for the present at least, none England at the moment resembles a steam boiler with an increasing pressure and no safety valve In Italy, Signor Mussolini is encouraging large families with the view of increasing the importance of the Italian nation By his skilful development of the natural resources of Italy, room is at present being made for the increase But it is obvious that this process will soon reach its limit, and then Italy will become another dangerous centre of tension

The recent census of India revealed that an increase in the population from 320,000,000 to 350,000,000 has taken place in ten years The Indian peasant always lives on the barest minimum of subsistence, which is all that can be wrung from his small plot of land It makes one shudder to think of the intensification of that dull, sordid struggle and the consequent misery involved in the necessity of feeding 30,000,000 extra mouths A distinguished Anglo-Indian friend once told us that in one of the islands of the Ganges delta three-quarters of the population were wiped out by an inundation, ten years later that island was distinguished by its prosperity over all the other parts of the delta No wonder some cynics sigh for the good old days when, at intervals, life was diversified by plagues and invasions which produced temporary excitement and discomfort and relieved the pressure of population This pressure is one of the results of British rule and British humanitarian sentiment

Humanitarian sentiment acting in ignorance of the laws of biology is a most dangerous thing and produces devastating results Compulsory birth control seems to us to be the only remedy capable of averting these results Truly, though hardness of heart be given divine condemnation, Nature is equally severe on stupidity and wilful ignorance

E W MacBride

The Rise and Growth of Applied Entomology

Smithsonian Miscellaneous Collections Vol 84 *A History of Applied Entomology* (*somewhat Anecdotal*) By L O Howard (Publication 3065) Pp viii + 564 + 51 plates (Washington, D C Smithsonian Institution, 1930)

THE title of this volume suggests a severely technical contribution It is, in fact, a technical contribution, but one leavened with anecdotal and humorous facts and foibles respecting personalities that figure in its pages It traces the rise and growth of applied entomology very largely through the lives of those whose efforts have built up the subject The document before us is, in consequence, of a very human interest, and in its author we have the doyen of the world's economic entomologists Dr Howard's long career as Chief of the United States Bureau of Entomology renders him exceptionally well qualified for the task of writing this book Probably no one else has established so many personal contacts with entomologists from all over the world His own travels, so often over North America and into Mexico, and in many European countries, have enabled him to learn much about conditions first hand Further, Dr Howard's office in Washington has long been the Mecca of all entomologists who sought to widen their experience by visiting such American organisations as he advised In his retirement he has made good use of his time by placing on permanent record a rich harvest of facts and impressions gleaned from innumerable sources

This volume is largely divided up geographically into separate parts and, as stated in the preface, it is not a history of the strict, modern, documented type In Part I (pp 9 198), Dr Howard traces the various factors and influences that have led to the great development of his subject in North America Much is related concerning the lives of the early American exponents of economic entomology, their individual traits and how each person influenced the trend of events A good deal is told about individuals and circumstances which we do not recollect having seen in print before As isolated reminiscences these records are merely interesting, but when woven into an historical fabric of this kind, they help to recast a proper perspective of times now gone by. Dr Howard extends just praise where it is due, yet the foibles of individuals are not overlooked, and he manages to incorporate much that is entertaining in an anecdotal way Individuals make institutions, and among the latter the leading State, Federal, and non-official organisations are explained and their developments followed

The inauguration of journals and of societies comes in for its share of recognition, and their metamorphoses are followed up to the present day. The teaching of economic entomology, from its early beginnings up to the great modern schools at Cornell and elsewhere, is recounted teachers and their methods are characterised, while, here and there, something pertaining to their audiences finds expression The major campaigns of insect control in the United States are discussed in an interesting and informal manner quarantine and other acts come in for historical record and their consequences clearly indicated Public expenditure, political events, and also the salaries of entomologists, all come under review Canada and Mexico find their due places in this section of the volume An exceptionally full account is given of applied entomology in Mexico, possibly because it is so little known, and here it seems perhaps a little anomalous that the more extensive, and older, developments in Canada are discussed in the same number of pages

Dr Howard concludes that the enormous damage incurred by insects demands many more men to cope with it in America, even more than in any other part of the world "Surely", he says, "we appreciate their need more than any other country And that is the reason why the United States stands at the head in applied entomology."

Part II (pp 201 336) deals with European countries It opens with sections on the early writers and their work, and then passes on to discuss at length the effects of the entry of the *Phylloxera* on to the Continent It would seem, Dr Howard says, that this pest proved a blessing in disguise, for the reason that serious work in applied entomology originated very largely in some countries as the result of the check to viticulture administered by this insect He then proceeds with his main subject, taking it country by country The early struggles that applied entomology underwent in order to obtain recognition in the British Isles are admirably followed When we come to later developments, we find an appreciation of the work of the Imperial Bureau of Entomology, and due compliment is paid to the world-wide value of its publications Reference will also be found to the influence of the Development Commission, the Empire Marketing Board, Carnegie studentships, and other organisations that have tended so much to the furtherance of the subject

In dealing with France, the development of the State organisations is traced, and a special section is devoted to personalia with respect to the savant Paul Marchal and the outstanding work accomplished by him Similarly, when we come to Italy, we find just tribute paid to F Silvestri, who is, perhaps, the most learned and experienced general entomologist to-day The accounts of developments in Russia and Poland are particularly enlightening, and Dr Howard's visits to both these countries have enabled him to garner information from personal experience So each country is taken *seriatim*, and there are not many that our author has not visited at one time or another, often on several occasions He is thus able to impart much that is both interesting and significant respecting its leading applied entomologists in every story Even Cyprus, its problems, and its young Government entomologist find a place in this section of the volume

Parts III to VI (pp 339 462) are concerned respectively with Asia, Africa, Australasia, and Central and South America Here, a good deal that is unfamiliar is placed on record, and many little known persons are brought into the limelight and their services appraised Most of us know little as to what has gone on in Uruguay, Guam, or Haiti, for example, but Dr Howard has dispelled this ignorance with many interesting facts respecting both persons and institutions in such parts of the world

Part VII (pp 465-545) is mainly concerned with the growth and development that medical entomology has undergone during the last fifty years Dr Howard's own early medical training has given him a lien towards this aspect of insect control By means of his writings and his personal influence, he has done inestimable service in making discoveries widely known, and in moulding American public opinion into realising the menace of insect-borne diseases This part of the volume is rich in personalia, and we find therein many reminiscences of such leaders as Ross, Blanchard, Grassi, and others, too many for separate mention Biological control, also, has its place in this part the history of the practical utilisation of parasitic and predatory insects is traced, and what has been achieved by way of biological control in different countries recounted The three concluding sections of Part VII are short but to the point In one, the growth of the appreciation of applied entomology by other scientific workers is discussed and analysed This is followed by a numerical comparison of applied entomological literature that has emanated from different countries, and it appears that, in less than fourteen years, no fewer than 23,430 papers and books on the subject have appeared in the world ! Finally, Dr Howard has some cogent remarks on the future outlook for the control of insect pests

At the end of the volume are 51 half-tone plates which contain about 250 portraits of applied entomologists who have contributed, or are still contributing, to the advance of their subject The originals of many of these are in the unique collection that Dr Howard has gathered together and filed in Washington over a long period Many visitors from afar have faced the camera at his instigation, but few realised that they were destined to feature in the present volume ! Following the plates is an 18 pp index listing more than 5000 names of individuals that are mentioned in the text of this volume all, in some way or other, have exercised influence upon applied entomology

We must conclude this notice by extending our gratitude to Dr Howard for giving us quite a monumental volume It is one wherein his own inimitable personal touch has imparted to it a character not only unique and entertaining, but also of enduring interest as an historical record

A D Imms

Scientific Aspects of Disarmament

Scientific Disarmament a Treatment based on the Facts of Armament By Victor Lefebure Pp 320 (London Mundanus, Ltd , 1931) 5s net

In the numerous discussions on disarmament during the last twelve years, the ethical and moral aspects have been emphasised out of all proportion to the other factors The moral aspect of war has been debated for centuries, but has essentially no relation to the problem of disarmament as it presents itself to-day Even if we take the Quaker point of view, we cannot afford to wait for the spiritual conversion of whole nations, civilised and uncivilised, to the same doctrine of non violence There is nothing in history which justifies our relying upon such a transformation for the solution of an urgent and acutely dangerous problem It is indeed this failure to visualise disarmament as essentially a practical problem for our own generation that has led to so much dissipation of genuine moral support into sterile and unprofitable channels Had the energy diffused among a score of peace societies of one type or other been concentrated in definite support and

constructive criticism of the efforts of the League of Nations in this field, there would undoubtedly have been far greater advances towards disarmament As it is, our failure to grapple with the facts of disarmament still allows politicians, embarrassed by the conditional disarmament of Germany under the Treaty of Versailles but unwilling to make a positive contribution themselves, to find an easy refuge in moral and economic platitudes

Disarmament presents itself at the moment as essentially a political and a technical problem, and on the whole the emphasis is on the technical aspect The extent to which the Pact of Paris has changed the fundamental situation is as yet scarcely perceived, and once the logical sequence of the fact—the renunciation of neutrality—has been publicly recognised by the Great Powers, the political situation should no longer offer any real obstacles to progress Indeed, the acceptance of this principle by the United States of America would probably be decisive

On the technical side, it is significant that the study of disarmament which has already been carried out by the League of Nations has demonstrated that disarmament is a practical proposition, and discussion now centres not on the possibility but on the mechanism of disarmament To this discussion, Major Lefebure's volume makes a contribution of fundamental importance Disarmament is largely a technical matter Its successful treatment depends on the impartial analysis of all the relevant facts The failure or halting progress of most efforts in the field of disarmament has been mainly due to failure to visualise clearly the main *objective, and as a result to treatment of the problem in fractions* "Scientific Disarmament" *gives us essentially a projection of scientific method* into the disarmament problem—the application of those principles of observation, analysis, and deduction upon which are based all the advances of pure and applied science

Starting with the assumption—to day a definite principle of international policy—that we can no longer afford to settle our national disputes by war, Major Lefebure views disarmament as essentially the problem of securing sufficient periods of time free from hostilities for the success of the alternative methods of peaceful settlement Before any practical steps can be taken, a really thorough and informed exploration of technical disarmament must be undertaken, and the main purpose of the book is to urge the necessity of such an investigation Without it the efforts of the Disarmament Conference, to be held in 1932, are likely to be fruitless, and failure of such a world conference would seriously prejudice the cause of disarmament for years

Ten years ago, in "The Riddle of the Rhine", Major Lefebure established the vital relation between chemical warfare and industry, and exposed both the fallacy of a disarmament policy which ignored the new agencies of war, and the futility of the abolition of chemical warfare without the elaboration of definite measures of control Industrial developments during the last decade have reduced some of the disparity between the chemical industries of the Great Powers, but in the discussions on disarmament chemical warfare has received cursory or only sentimental treatment In spite, however, of the intricate relations between the various agencies of chemical warfare and chemical industry, the conceptions of armament potential and of conversion lag operate as effectively as in other fields If our normal productive capacity is sufficiently low, the time characteristics of the production of armaments of every type involve a delay of anything from six to eighteen months, which renders quantity limitation a feasible and valuable disarmament measure Great stocks of war chemicals used in industry have no meaning for war unless the appropriate containers or chemical weapons have been designed

The soundness of this argument will be appreciated by all who have been concerned with industrial development or expansion, but the question of type is equally important The facts advanced by Major Lefebure indicate that agreement on the types of armament to be retained and limited, and the sup*pression of all other existing types, is also an essential* condition of efficient disarmament The existence *of private manufacture and traffic in arms appears* to be inconsistent in a genuine scheme for disarmament Even an investigation such as that contemplated by Major Lefebure, however, will require much publicity and very emphatic support from public opinion before its recommendations on these questions of armament types, the traffic and manufacture of arms and of combatant conversion involved in the conscription issue, are accepted in the face of opposition which can well be imagined

A significant fact in the history of armaments is the failure of military authorities to recognise the importance of new types of armament The extent to which chemical warfare dominates the armament field is even yet not generally realised, and it is doubtful whether even military or naval opinion appreciates the degree to which the new agencies

of war have increased not only its deadliness but also the difficulty of forecasting its issue Security is now conditional upon disarmament In such circumstances, uninformed action may create an invisible disparity of armament which may lead to war through encouraging some nation to believe in the possibility of its overwhelming success The only disarmament policy which can hold out any hope of success is one based not on opinions but on scientific investigation of the facts which can be ascertained, and on scientific control of the critical technical factors involved Until such a scientific policy has been elaborated, the political factors are largely irrelevant Once in possession of a scientific policy that is technically sound, the hitherto ineffective moral and ethical forces can be marshalled to overcome any lingering opposition in the political field

We may admit that the application of science has made warfare too dangerous an instrument to be used in national policy, but it is equally true, as Major Lefebure reminds us, that science holds the key to disarmament The problems of control are not insoluble and will yield to treatment along scientific lines The elaboration of a scientific disarmament policy is a task in which scientific workers can help, and is urgent and essential if civilisation is to regain control over the destructive powers released by the application of scientific discoveries A study of disarmament is an integral part of that scientific study of international affairs through which alone can ultimately evolve the logical requirement of the Pact of Paris—a science of peace

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Positive Rays

Canalstrahlen Von E Goldstein (Herausgegeben von E Gehrcke) (Ostwalds Klassiker der exakten Wissenschaften, Nr 231) Pp iv + 86 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 4 80 gold marks

THIS selection of the late Prof Goldstein's papers, on positive rays and the cathode glow, is reprinted with only two trivial alterations, both due to Goldstein himself One cannot but admire the accuracy of his observations, especially in the first paper (1886), the ultimate outcome of which is now the mass-spectrograph and the two main methods—Brose's and Stark's—for the electrical resolution of spectra

At the same time, it must be admitted that a great deal which Goldstein described has yet to be fully explained, in particular, the origin of the light which appears on the cathode surface inside the Crookes's dark space, and the exact nature of the curious small bulbs of light which form at a hole in the cathode, or at its side, when the discharge strikes to the back of this electrode Goldstein was careful to point out that the former had probably a dual origin, some of the rays to which it was due coming from the cathode and some going towards it, but the elucidation of conditions at the cathode surface remains one of the major problems in connexion with discharge tubes The position with regard to the bulbs is also obscure, it is known that tubes exhibiting them often, if not invariably, act as generators of high-frequency oscillations, but there is no explanation of why this should be so, or even a satisfactory electrical description of the bulbs, whether they are local concentrations of positive rays or local discharges of an arc type

It is interesting to notice that Goldstein gave the correct explanation of the repulsion of the discharge from the walls in the dark space, and of its attraction in the negative glow (in the dark space, he supposed that the walls acted as an anode, and in the negative glow as a cathode), and also that he came near to discovering Brown and Thomson's shadow method for finding potentials in the dark space The least satisfactory sections of the reprints are those dealing with the ray patterns that form on polygonal cathodes, where he has succumbed to the temptation, always present in discharge work, to spend time on phenomena which are rather beautiful and probably not of much fundamental importance

The publication of these papers in book form is a considerable convenience to anyone interested in research on the glow-discharge, as well as an appropriate supplement to von Traubenberg's appreciation of Goldstein in last year's *Die Naturwissenschaften* K G E

Our Bookshelf.

A History of Modern Culture the Great Renewal, 1543–1687 By Prof Preserved Smith Pp xi + 672 (London George Routledge and Sons, Ltd, 1930) 12s 6d net

SEEKING as we do in these pages for every manifestation of the new spirit in the conception of history, we welcome with especial warmth the first volume of Prof Preserved Smith's "History of Modern Culture" Here is an author who opens his account of the seventeenth century boldly by saying that "of all the forces moulding modern life, science has been the greatest It can be shown that all other changes in society are largely dependent upon this" We have just said 'seventeenth century',

but the author himself is careful to extend his limits on the earlier side to 1543, and calls his period 'The Great Renewal', which he thinks we should interpose between Renaissance and Reformation which precede it, and the enlightenment which follows in the eighteenth century Whatever we may think of this division, it has the great advantage of including at one end the work of Copernicus and Vesalius and at the other the foundation of the Newtonian system, with Galileo and his fight with the Inquisition in the central point

The sciences thus form the subject of Part 1 of the book, the humanities of Part 2, social control, which includes education, religion, and law, Part 3, while literature, art, and morals find their way together into Part 4, called the "Spirit of the Times" This arrangement might, no doubt be improved, and it is disconcerting to find a full and admirable chapter on the arts, to say nothing of literature, inserted as an item in the "Characteristics of the Times"

On the matter, the only comment we feel inclined to make is that Prof Smith looks at the culture or civilisation of his period rather too exclusively through the eyes of the writers of books and the painters of pictures One would like to hear more of what the common people did and thought, and how they lived and moved in the period On this side, G N Clark's recent work on the seventeenth century is an interesting contrast But as a history of thought, Prof Smith's book is easily the best we have seen F S M

Wit and Wisdom in Morocco a Study of Native Proverbs By Dr Edward Westermarck, with the assistance of Shereef Abd es-Salâm el Baqqālī Pp xi + 448 (London George Routledge and Sons, Ltd, 1930) 25s net

In this volume, Prof Westermarck completes his trilogy on Moroccan customs and ideas The three books, "Marriage Customs in Morocco" (1914), "Ritual and Belief in Morocco" (1926), and "Wit and Wisdom in Morocco", are the fruit of nine years' experience of the country and its people, spread over a period of three decades In the two earlier works, Prof Westermarck showed to what advantage he had turned his opportunities for observation from the last we are in even a better position to judge what a wealth of intimate knowledge of the psychology of the people and of their everyday life lay behind his interpretation of custom and belief in the earlier studies

The author has here given the literal translation, with explanatory comments, of a large number of proverbs classified under subjects and the text in Arabic script It may be remarked in passing that there are considerable differences between the written and spoken language, which the author sets forth in detail An introductory essay deals elaborately with the form and content of the proverb, and discusses at some length its significance as an index to the character and culture of the people Prof Westermarck points out that the Moroccan proverb shows very marked traces of the influence of Islam, especially in its attitude to women On the other hand, he adds a much needed word of caution as to the employment of the proverb in diagnosing the prominence or absence of any given feature The fast of Ramadan, for example, is not even mentioned in any proverb To conclude that it was therefore of no importance or significance in Morocco would be entirely erroneous, as it is rigorously observed

Collected Geometrical Papers By Prof Syamadas Mukhopadyaya Part 1 Pp viii + 157 (Calcutta Calcutta University Press, 1929) 4 rupees

The papers in this collection number ten on plane curves and seven on non Euclidean, mainly hyperbolic geometry The papers of the first group include six dealing with such topics as the geometrical theory of a plane non cyclic arc, cyclic and sextactic points, and a generalised form of Böhmer's theorem, in which methods of pure geometry are employed, in several cases new methods of considerable interest In this group, there are also four papers on the general theory of osculating conics, in which the methods of differential geometry are applied in rather a novel manner The papers of the second group also offer some new features, and amongst a number of interesting results may be noted an extension of the well known correspondence between a right angled triangle and a three right angled quadrilateral in hyperbolic geometry, so as to include a regular pentagon The book can be recommended to all who are interested in geometry, whether Euclidean or not, and wish to learn something of the progress of geometrical studies in Indian universities

The Papyrus Ebers Translated from the German Version by Cyril P Bryan Pp xl + 167 + 8 plates (London Geoffrey Bles, 1930) 10s 6d net

Lest intending readers may be disappointed, we hasten to inform them at the outset that this book is not a translation in the usual sense of the German version of the famous medical papyrus obtained in Egypt by Ebers in 1870 It is, in fact, a running commentary with a selection only of some of the medical formulæ or prescriptions taken from "the oldest book in the world"—it dates from 1500 B.C.—and classified according to their subject matter diseases of the alimentary system, minor medicine, minor surgery, the urinary system, diseases of women, of the skin, eye, ear, nose, and throat, and so forth In a few cases only does the author quote the magical invocations which played such a prominent part in the healing art of ancient Egypt

Nevertheless, the prescriptions themselves are a remarkable collection, as exemplifying the curious and bizarre forms assumed by the magical idea The chapters containing the actual prescriptions are preceded by others which deal with the age, history, and form of the papyrus, the pharmacopœia, the mineral, plant, and organic materials

used, and the relations of the gods to disease Prof Elliot Smith has contributed an introduction, in which he briefly reviews the progress of the study of the pathology of ancient Egypt, to which he himself has made no small contribution during the last thirty years, and, secondly, points out the value of the Ebers papyrus as a basis for the com parative study of folk medicine, quoting as an example the use of the mouse in folk-healing, which is found in ancient Egypt and survives in England to day

Differential Equations By Dr Forest Ray Moulton Pp xv + 395 (New York The Macmillan Co, 1930) 24*s* net

DR MOULTON'S book is written on a novel plan, in so far as no attempt is made to cover the whole field of differential equations Elementary methods of solution of standard types of equations, singular solutions, solutions by definite integrals, and partial differential equations are omitted altogether, but general classes of ordinary differential equations, the nature of their solutions and integrals, and general methods of determining them are treated fully and with unusual rigour

There are very complete accounts of the method of variation of parameters, the method of successive integration, including its application to the numeri cal solution of equations, and the Cauchy Lipschutz process Linear differential equations, with con stant and periodic coefficients, are considered fully, particular attention being paid to the cases of mul tiple roots of the characteristic and fundamental equations Finally, there is a chapter on differential equations with an infinite number of variables with astronomical applications The general theory is illustrated by applications to specific problems, including elliptic motion, the sine amplitude function, the deviations of falling bodies, and the damped gyroscope

The book is not one for the beginner, but can be highly recommended to the advanced student who seeks information on the general methods of solution of the types of equations treated, as well as to the astronomer and mathematical physicist who need to apply these methods to particular equations met with in their researches

The Annual of the British School at Athens No 29, Session 1927–1928 Pp x + 351 + 25 plates (London Macmillan and Co, Ltd, n d) 63*s* net

THE twenty-ninth Annual of the British School of Archæology in Athens covers the operations of the School for the session 1927–28, when the major excavation at the temple of Artemis Orthia at Sparta was in the nature of a final clear up The director, Mr A M Woodward, therefore devotes himself to a report on the remainder of the inscriptions, mostly of office-holders, and, with M L Robert, discusses at some length four Hellenistic decrees, of which the number found elsewhere at Sparta is exiguous These deal with a proxeny conferred on a Spartan by Arcadian Orchomenos, decrees in favour of Spartan dicasts by Eretria and Demetrius in Thessaly, and an incomplete decree of Tralles Mrs Woodward deals with an interesting group of archaic terra cottas from the Acropolis, presumably votive offerings to Athena Chalkioikos or the warlike Aphrodite, whose temple was behind the Chalkioikos Mr W A Heurtley, assistant director, has continued his work on out-lying early sites, and describes the excavation of two mounds situated in Chalkidike with settlements of the neolithic and bronze ages, which are compared with sites previously excavated by the School at Vardaróftsa

School Botany By Dr Macgregor Skene Pp vii + 243 (Oxford Clarendon Press, London Oxford University Press, 1931) 3*s* 6*d*

MANY teachers of biology are opposed to the introduction of botany and zoology as separate subjects in the school curriculum before the age of specialisation, the higher certificate phase Nevertheless, there are still plenty of syllabuses of botany designed for matriculation examinations, and it is this standard of work which Dr Skene has had in mind in preparing his " School Botany " Whether many of these syllabuses can be said to be ' covered ' by reference to the flowering plant alone is open to doubt But flouting the examination bogy and taking the book on its merits, as matter for profitable study, it attains distinction in its class The treatment is practical from beginning to end, the plants are really live things, whether in the laboratory or in the field, and so clearly is it expressed that a pupil could do much useful work with very little supervision The style flows easily, contact is made with the historical aspect as well as with the other branches of science, and the illustrations are few but good The book can be specially recommended for use with groups of boys or girls of any secondary school age as part of their general education or as the subject of a holiday task

The Dissection of the Frog By Dr R H Whitehouse and Dr A J Grove Pp x + 101 (London University Tutorial Press, Ltd, 1930) 2*s*

THE type system in anatomical teaching is an unconscionable long time dying, and the frog remains an incongruous figure in the centre of the system Every young anatomist learns that the frog is the type of types, and that every other creature is either a ' lower ' type or a ' higher ' type Yet the frog is but an aberrant amphibian, far from the main stream of evolution, and were it not for its convenient size, widespread occurrence, and prolific breeding, it would probably have been overlooked by the selectors of types This is no disparagement of the very compact little book under review, which, in fact, contains a great deal of useful advice about laboratory practice in addition to a clear exposition of the anatomy of the frog The authors hold out high ideals for the teacher, for the student, and for the work of the class If the time factor makes it impossible to carry out their ideals in the letter, the spirit should result in the replacement of much ineffectual copying by honest thinking

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Theory of Geological Thermal Cycles.

In a review of the second edition of Prof. J. Joly's "Surface History of the Earth" (NATURE, Feb. 14, p. 227) Prof. A. Holmes makes the rather sweeping statement that the proposed mechanism for the alternating accumulation and discharge of heat seems to be physically unacceptable. He appears to justify this view from Dr. Jeffreys' opinion, who originally based his condemnation of the theory on the fact that there is no periodic solution to the equation giving the heat flow in a solid medium. When, however, change of state occurs in the medium, we have to allow both for the motion of the medium itself and also for the latent heat of fusion, and obviously the original differential equation will have very little bearing on the result. Dr. Jeffreys, in his second edition of "The Earth", has simply solved this problem by assuming that if at any depth the radioactive materials were sufficient to raise the medium above the melting point, then the resulting convection currents would exactly carry off the excess heat and a steady state would again be attained. Mathematically, this is equivalent to assuming that the effective conductivity of the medium would adjust itself to give the required heat flow at the required temperature gradient. It is not often that Nature is so accommodating.

It is possible, nevertheless, to discuss the problem mathematically rather more fully, and I have attempted to do so in a paper on "The Thermal Instability of the Earth's Crust" published in the *Scientific Proceedings* of the Royal Dublin Society, vol. 19, No. 32. In this paper it is shown that assuming a basaltic crust with a definite melting point and latent heat, and a melting point pressure curve steeper than the adiabatic for the liquid state, conditions which ordinary basalt apparently fulfils, then periodic partial melting and resolidification of the crust, if it exceeds a certain depth, appear to be physically inevitable, quite apart from any tidal or other effects. This result certainly must be applied with caution if the crustal materials have no definite melting point. Personally, I consider that if these materials are capable of existing over a certain range of temperature and pressure as two phases which differ greatly in viscosity and total energy content, then it is probable we are justified in doing so. If, on the other hand, they pass slowly from the liquid to the solid or highly viscous glassy state so that their viscosity and energy content at a given temperature and pressure are always single valued, then probably Dr. Jeffreys' assumption would be correct. Enough, however, has been said to show that Joly's original theory of thermal cycles cannot be dismissed as in any way physically impossible or improbable. The whole question ultimately hangs on the real properties of the substratum.

Turning to a second point in Prof. Holmes's review, he objects to Joly's theory on the ground that it leads to an alternation from world-wide tension to world compression, which he says he finds geologically unacceptable. To get over this difficulty he has proposed a system of large-scale convection currents in the substratum in which the stresses in the surface crust are due entirely to this current motion. In this, he neglects the fact that if thermal energy is accumulating at any time in the subcrustal materials, they must tend to expand, due either to ordinary thermal expansion or to increase of volume on fusion, and that therefore such epochs must on the whole result in increased tension in the outer crust. The only escape I can see from this impasse is to assume that the progress of energy accumulation and discharge is not simultaneous over the whole earth. It would appear easier to do this on Joly's hypothesis than on Holmes's modification of the theory. Besides, it is not at all certain that there is no evidence for world wide tension and compression. It is usually held that mountain building epochs, that is, states of compressional strain, are more or less world wide and contemporaneous, and if the evidence for world wide tension is not so obvious, this may be due to the fact that it has largely been taken up in the ocean floor, where its effects would not be so open to our inspection, as Joly has already pointed out. It is perhaps also not without significance that the so called common fault in geological science is a tension fault.

To refer to another matter: the connexion which Holmes has emphasised between the state of the outer shell of the earth and terrestrial magnetism appears to be most important. On Larmor's convection current theory of the origin of the earth's magnetic field, we might expect the strength of the field to increase largely in times of revolution when the subcrustal materials are most fluid. Mercanton, of Switzerland, has already attempted to determine the direction of the field at various geological epochs by investigating the direction of magnetisation of lava flows of different ages, and it is just possible that by measuring their intensity of magnetisation some information as to the strength of the earth's field at the time of solidification might be obtained. The problem is not a simple one, since the intensity of magnetisation would depend, not only on the field strength, but also on the chemical composition of the various lavas, and possibly other variables. It indicates, nevertheless, a new avenue of approach to the problem, which might yield some interesting results.

J. H. J. Poole.

Trinity College, Dublin,
Feb. 24.

When I wrote my review of the second edition of Prof. Joly's book several months ago, I had not seen Dr. Poole's paper, but the ideas which he there treats mathematically were by no means new to me, for I had already envisaged them in a qualitative way in my paper "Contributions to the Theory of Magmatic Cycles" (*Geol. Mag.*, 1926, p. 315 *et seq.*). So far from denying that they have important applications, I have since attempted to develop the principles involved, especially in their relation to problems of petrogenesis. In stating that "Joly's mechanism of alternating accumulation and discharge of heat seems to be physically unacceptable", I had particularly in mind the probable distribution of radioactivity through the whole of the earth's substratum, that is, down to a depth of 2900 km.

Joly and Poole appear to assume the existence of a thick layer of material of basaltic composition through which successive waves of fusion develop, pass upward, and die out, this layer being underlain by a lower layer of crystalline rock. The latter conception has hitherto been tacit, but Poole has given it definite expression in the paper to which he refers. On p. 405 he speaks of "a lower infusible layer, such as probably occurs in the earth's crust". In the light of all the relevant evidence, I can see no reason

for making such an assumption Its adoption implies the belief that the material below the 'basaltic' layer is practically free from the radioactive elements The data and principles of geochemistry (involving in particular the known partition of the radioactive elements between basaltic rocks and peridotites, and between stony and iron meteorites) seem to me to make it incredible that the radioactivity of the deep substratum can be ignored Kimberlite, which cannot be a differentiation product from basaltic magma and presumably comes from a deeper level of the substratum, as convincingly argued by Wagner, provides the only direct evidence yet available, and it confirms the deduction that the substratum is far from being devoid of the radioactive elements But this being so, the substratum cannot yet have cooled to a crystalline solid, it must still be an extremely rigid and viscous glass discharging heat with the aid of convective circulation On this view, the earth has not yet reached the stage of its thermal history when the conditions visualised by Joly—or the still later conditions of contraction adopted by Jeffreys—could begin to control geological events

Dr Poole's second point is fully referred to in my recent paper on "Radioactivity and Earth Movements" (*Trans Geol Soc Glasgow*, vol 18 for 1928–1929, pp 559 606, 1931) The view is there developed that tension arises where ascending convection currents approach the under surface of the crystalline crust and turn along in opposed directions, and that compression arises where the lateral currents of adjacent circulation systems approach and turn downwards One effect of this compression is the local transformation of the material of the 'basaltic' layer into eclogite, a metamorphic change involving marked decrease of volume and consequent sinking of the denser material The convection theory requires simultaneous compression and tension in different regions of the globe It certainly does not imply systematic world wide expansion of the substratum or tension of the crust The internal excess of heat is discharged partly by the slow growth of new geosynclinal or ocean floors over the sites of rising currents, partly by the heating up and fusion of sinking eclogite blocks in descending currents, and partly by igneous activity of the familiar kind, the latter representing effects at and near the surface which are thought to be brought about largely by processes such as those discussed by Dr Poole in his papers on "The Thermal Instability of the Earth's Crust"

ARTHUR HOLMES

The University, Durham,
Mar 5

Novelty throughout Nature

IF I characterise a kind of evolution as advance through new products towards further novelty, there are many who will roundly deny that there is evidence of anything of the sort Hence a live issue.

(1) Let us first in some way define novelty In a preliminary way one may say that what is new could not be predicted before the event of its first occurrence Here the stress is on 'before the event' After the event, the recurrence of like events in like circumstances may be predictable

A distinction is sometimes drawn between 'real' and 'apparent' novelty, and then it is said Given adequately comprehensive knowledge of Nature, all that is apparently new could have been foretold and is therefore not really new. Such a distinction confuses the issue This or that either *is* new and unpredictable before the event of its first occurrence *or*, as predictable on the basis of knowledge up to-date, it is *not* new

We have then to correlate 'up to date' with 'before the event' One has reference to knowledge, the other to the course of Nature as thus far known Here the emphasis falls on 'thus far' The evolution of knowledge may itself be an advance through new products towards further novelty

(2) Let us now ask What is it that is new? If one may liken that which goes on in an atom, a molecule, a crystal, a living organism, a mind, to a 'game' that is played in the field of Nature, one may submit that in each case the relational conditions under which it is played are new, that the rules of the game are new, that the characterising features (qualities and properties) of the players are new

(3) In any practical inquiry on the part of a specialist in some branch of science, he commonly starts with a state of affairs which is (let me say) 'prescribed', in the sense that this is just the kind of game that he finds already in progress with repeated routine of procedure as heretofore But what is thus prescribed may be the 'recurrence' of that which at some earlier stage of evolutionary advance was new, in so far as the relational conditions of its first 'occurrence' were unprecedented

In further detail, the procedure of the man of science may be on this wise In some advancing process, he selects three stages, spaced at discretion, with or without intervening stages, and he commonly narrows them down, here, there, or elsewhere, so as to get them as close set as possible He then concentrates attention on the mid stage He may deal, for example, with vapour and liquid, liquid and solid, with atom and molecule, molecule and crystal, with matter and life, life and mind In each case he seeks to fill in the 'and' which stands for 'pass age to'

Take the first case of vapour, liquid, solid Having at hand many samples of all three, he learns all that he can of the passage of one to the other under differing conditions But this, though it may suggest, does not bring him face to face with the question of novelty from the evolutionary point of view That question may be thus stated If the cosmic order of advance has been from vapour through liquid to solid, could anyone have predicted liquid (not yet in being) from the platform of vapour in some hot star? Or solid from the platform of liquid on a cooling planet? Or are there new rules of each game which could not be predicted before it was in play?

Similar in principle are, among many others, the questions From the atomic platform could the molecule and the crystal be predicted? From the platform of lifeless matter could life and mind be predicted?

In *all* cases the answer may be, Yes Then the whole course of evolution is devoid of a single example of novelty If in *some* cases the answer is No, we must in some way characterise that kind of evolution in which they obtain and formulate generalisations as to how, when, and where some new game supervenes on those already in play

(4) It may here be said that prediction implies a basis of knowledge, and that on the platform of lifeless matter there was as yet no knowledge Can we escape the predicament in which we are thus placed? Some logicians reply that we can

No doubt, we cannot discuss natural advance save in terms of our knowledge thereof But we can ask whether, given all those generalisations which have reference to the atomic game (let us say), one is in a position to deduce therefrom all the generalisations

which have reference to the molecular game And so on with regard to other games

Apart, then, from an evolutionary order of advance, we now ask Are all games *now in play* such as to enable the skilled logician to deduce from any one of them the rules of all others and the characterising features of the players? If so, no one of them affords an example of novelty

Hence it seems that our cardinal issue largely hinges on a logical issue to be decided by those who know not only the rules of this or that Nature game but also the rules of the game of logical deduction If there is divergence of expert opinion, those who are interested amateurs in logic must leave the decision *sub judice* That still leaves it open to them to believe that there is novelty throughout Nature

(5) Meanwhile, men of science pursue their inquiries and formulate generalisations founded on observation and experiment Let each speak as he finds and thus bring fresh data as grist to the logical mill In the field of animal behaviour I find much that I can predict fairly confidently if I know the precedent life history of the individual That which I can thus predict is the recurrence of such and such a manner of behaving in these circumstances or those

None the less, at all levels of behaviour, I find well organised examples of novelty which I did not foresee In each individual, high or low—but more conspicuously in those of higher status—I find subtle nuances of variation from the stereotyped routine of recurrence The more closely I observe the behaviour of this or that animal, however lowly in estate, the more am I impressed with some tincture of that kind of unpredictable variation which affords an example of novelty at its birth Such unforeseen departures from routine seem to exemplify new products, and they may be stepping stones on a line of evolutionary advance towards further novelty

If this be so, it is novelty that *leads* in the forefront of such advance But it leaves in its wake a trail of prescribed routine We thus pass from novelty in precedent behaviour to relative fixity in consequent routine, subject to the proviso that were there no novelty there would be nothing to fix We pass to certain rules (of 'conditioning', 'inheritance', and others) which are distinctive of the life game as such, rules which are learnt only through prolonged observation and experiment Into these I need not enter, since novelty is my theme

(6) My plea is for the recognition of novelty throughout Nature My thesis is that novelty is no less natural than is prescribed routine If we start with established order in routine, the introduction of novelty may be said to call for some 'alien influx into Nature' The question then arises Whence comes this novelty? The reply of those who keep within the limits they assign to scientific inquiry may be It is no part of *our* business to say whence comes Nature or aught within Nature We leave that to others If we find novelty therein, we are content to accept what we find as we progressively build on the foundations laid by observation and experiment

If, however, novelty in some way leads to routine we must budget for some such generalisation as this When in the course of advance there supervene new relational conditions and new products with new characterising features, the recurrence of these conditions always entails the recurrence of those characterising features

Herein there is nothing which contravenes a deep seated belief in the recurrent uniformity of Nature

C Lloyd Morgan

St Leonards on Sea,
Mar 2

Change of Susceptibility of Paramagnetic Salts under the Influence of Light

According to Bohr's theory of atomic structure, the colour shown by compounds of elements belonging to the transition groups is ascribed to the presence of incomplete inner shells in them, and to the small difference in the binding energy of an electron attached to the outer valency and the inner incomplete shell respectively Since the transference of an electron from the inner to the outer shell involves a change in its orbital moment, it is therefore to be expected that under the influence of light absorption the magnetic moment of the absorbing ion would also alter One of us tried to observe this effect several years ago without any success, due, as it appears now, to the arrangement used not being sensitive enough

According to Bohr's theory, the magnetic moment of an atom or an ion can only be due to the presence of uncompensated orbital moments of its bound electrons The hypothesis of the existence of spin moments in electrons introduced by Uhlenbeck and Goudsmit has considerably increased our understanding of intra atomic phenomena Attention has recently been directed by Saha (Nature **125**, p 163, Feb 1, 1930) to the part played by the spin moment of electrons in producing absorption in the visible region in certain paramagnetic salts

Saha advances the view that in a salt, like chromic chloride, the absorption in the visible region is entirely due to the outer electrons of the Cr^{+++} ion The most stable states of the Cr^{+++} ion are ^4F and ^4P, and the next higher ones are ^2H, ^2G, and ^2D The transitions from one to the other are brought about by the reversal of the spin axes of one of the d electrons of the Cr^{+++} ion The average difference in energy between the two sets of terms is about 20,000 cm $^{-1}$ (d – 4916 mμ), which is near the absorption region of Cr^{+++} From this, Saha concludes that the absorption of light in the visible region is due to some of the 'd' electrons changing their 'r' vector from $+\frac{1}{2}$ to $-\frac{1}{2}$

About the same time S Kato has, in a series of papers "On the Absorption Spectra of Salt Solutions" (*Sc Rep Inst Phy Chem Res*, Japan, vol 12, p 230, vol 13, pp 7, 49, 1930), shown that in the case of certain paramagnetic ions of vanadium, chromium, molybdenum, etc, in solution, their absorption spectra contain, besides regions of continuous absorption, also certain regions of selective absorption, for example, in the case of the violet solution of chromium chloride in water, she finds two selective absorption regions with wave lengths 4150 (24,100 cm $^{-1}$) and 5500 (18,200 cm $^{-1}$) These absorption frequencies are, according to her, in fair agreement with those emitted during the following transitions of the Cr^{+++} ion, $^4F' - {}^2H' = 20{,}718$ cm $^{-1}$ and $^4F' - {}^2G' = 14{,}758$ cm $^{-1}$, when the influence of the surrounding water molecules, etc, is taken into consideration The difference between the two observed absorption frequencies is 5900 cm $^{-1}$ and is in good agreement with the mean difference $^2G - {}^2H' = 5960$ cm $^{-1}$

As the transition of an ion like Cr^{+++} from its most stable state to the next higher one represents a reduction of its spin moment, then on the view that the magnetic moment of these ions depends mainly on their resultant spin moments (Bose, *Zeit f Phys*, **43**, 864, 1927), such transitions will always be accompanied by a reduction of their corresponding magnetic moments and therefore of the susceptibility of the salts containing them For some time past we have been engaged in investigating this subject and have obtained definite evidence of the lowering of the paramagnetic susceptibilities of solutions of compounds of iron, nickel, cobalt, chromium, and copper

For example, we took a solution of chromic chloride (green), which according to S Kato has the following absorption regions 4300 mμ and 6100 mμ Light from a mercury vapour lamp was passed through suitable filters to cut off entirely the infra-red radiation and to transmit either 4358 mμ or 5460 mμ and 5790 mμ only, and allowed to fall on a bulb containing chromic chloride (green) solution In the latter case, preliminary observation showed that the line 5460 is very little absorbed by the green chromic chloride solution In both the experiments, a definite lowering of the susceptibility was observed, as indicated by the deflection, in an inhomogeneous magnetic field with a steep gradient, of the small bulb containing the solution, which was suspended from a torsion arm Solutions of nickel and ferric chlorides, copper sulphate, etc, show selective absorption in the near infra red, and the decrease of their susceptibilities due to such absorption have also been observed These investigations, which have so far yielded only qualitative results, are being continued

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Feb 12

Negative Attenuation of Wireless Waves at Broadcast Frequencies

ATTENTION has been directed from time to time to negative attenuation observed on wireless waves propagating over land Ratcliffe and Barnett have noticed increase of field intensity with distance in their observations on Daventry (1600 metres) [1] Recently Barfield and Munro also noticed that the field strength of 2LO at a distance of 10 km was slightly greater than the figures calculated according to the well-known propagation equations [2] These

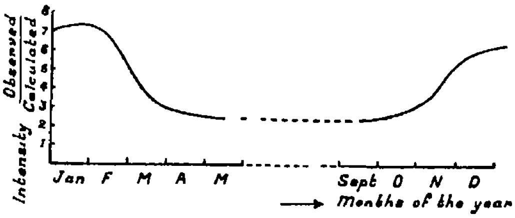

FIG 1—Ratios of observed to calculated values of field intensities of the Bombay Broadcasting Station for weekly averages of observed intensities The broken line represents monsoon period, when observation was impossible, due to thundery weather

observations refer to long waves of the order of 1600 metres or to short distance field strength experiments, at positions so close as 10 km from the transmitter

The present note deals with a type of negative attenuation effect observed on a 357 1 metre wave at a great circle distance of about 640 km Field intensities of the Bombay Broadcasting Station were measured in the laboratories and gave an average ratio of more than 2 5 1 between the observed and calculated values The ratio sometimes reached an abnormal figure of 7 1 in the early part of the year, dwindling down to about 2 1 about the middle of the year (Fig 1) These *consistent* abnormally high signal strengths are believed to be a clear case of negative attenuation at great distance from broadcasting stations

Three features of this service may be mentioned

(a) Excessive fading with periods of very strong signals
(b) General poor audibility with daytime transmission
(c) Abnormally strong signals during wintry months as compared with summer-time reception

It is suggested that the major part of reception is due entirely to the indirect or the sky ray, the ground wave being almost wholly absorbed The topography of the country intervening between the transmitter and the receiver lends support to this view. The former is situated at sea level at the base of a long mountain range, away from the receiver, which is itself about 3000 feet above sea level The mountain range is about 10,000 ft high and covered with dense tropical forest regions This would, no doubt, exercise considerable shielding and absorption effect on the ground ray

The propagation equations having failed to explain these abnormal results, attempts were made to apply Sommerfeld's theory of wave propagation on land, taking account of dielectric constant and ground conductivities The modified equations as obtained by Rolf [3] were used The ground constants and calculated attenuation factors are tabulated below

Authority	λ	Conductivity	Dielectric Constant	Attenuation Factor
Barfield	365	$6\ 4 \times 10^{14}$	10	0 18
Ratcliffe and Barnett	360	$11\ 7 \times 10^{14}$	10	0 025

From these factors, the observed value of intensities would appear to be 14 and 100 times the expected figures Apparently the ground ray is very feeble and the sky ray gives a strong signal of variable intensity It is significant to compare these ratios with the ratio of the observed indirect and direct ray intensities According to Eckersley [4] this ratio is 10 for a wave length of 375 metres and at a distance of 600 km from the transmitter

It is concluded that the negative attenuation effect referred to above is explained by the probability that the observed field strength is due entirely to the indirect ray, all propagation equations applicable to ground level transmissions giving signal intensities which are too low

S R KANTEBET
Communication Engineering Laboratories,
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[1] *Proc Camb Phil Soc*, vol 23, p 300
[2] *Jour I E E* vol 67, p 254
[3] *Proc Inst Radio Engineers*, vol 18 No 3
[4] Service Area of Broadcasting Stations, British Broadcasting Corporation's Private Publication

Variable High Resistance Grid Leaks

THE difficulty of obtaining very high resistances for certain forms of experiment can be overcome by the use of suitable photoelectric cells, as has been suggested by Messrs Adam Hilger, Ltd Not only have these the necessary resistance, but also they can be made to act with controlled variability as variable grid leaks This result we have obtained by mounting the photoelectric cell and grid connexions of a capless valve on amber and vitreosil, the valve itself being suspended in a ring of vitreosil The cathode of the photoelectric cell is attached to the grid, and the anode to whichever side of the filament is found most suitable The cell is completely darkened except at one point where it is exposed to a small lamp lit from batteries controlled by a

continuously variable rheostat The lamp connexions, batteries, and rheostat are contained in a screened tube and box, with the screen earthed to avoid variations due to the adjustment and handling of the rheostat

A large range of high resistance variation can be obtained by choice of the material of the cell and cathode, by the nature of gas used, or by degree of vacuum No battery is required, the difference of potential across the cell being merely the difference of potential between the grid and the filament leg to which attachment is made The apparatus in which use is being made of this variable high resistance is a modification of that described in the *British Journal of Radiology*, March 1930, for detection of the variable electric field of the human body

W E Boyd

Glasgow, Feb 25

The Velocity of Light

In Nature of Oct 22 1927 p 602, I summarised the observational evidence respecting the velocity of light In *Astronomische Nachrichten*, No 5530, I pointed out that this evidence is in favour of a decrease of this velocity, which is assumed to be constant owing to considerations of a theoretical order only

I have just heard of a determination of this 'constant' made by Karolus and Mittelstaedt (*Phys Zeits*, vol 29, pp 698 702, 1928) in July 1928 that is, since the last determination (299,796 ± 4 km /sec) made by Michelson at the beginning of 1926 The average of 755 measures gave 299,778 ± 20 km /sec It is remarkable that this is 18 km /sec *less* than the value obtained by Michelson, and falls in good alignment with the last three determinations made in the present century

1902 4	Perrotin	299,901 ± 84 km /sec
1924 6	Michelson	299,802 ± 30 ,,
1926 0	,,	299,796 ± 4 ,,
1928 5	Karolus and Mittelstaedt	299,778 ± 20 ,,

If the velocity of light is constant, how is it that, *invariably*, new determinations give values which are lower than the last one obtained, the observations distributing themselves so as to put in evidence an excellent linear law of variation, as can be ascertained by plotting the above results The graph does not show the slightest sign of a tendency to approach asymptotically a horizontal line It is frankly oblique to the axis of time There are twenty two coincidences in favour of a decrease of the velocity of light, while there is not a single one against it

The velocity of light is affected by magnetism, and the measurements of this 'constant' are performed in a magnetic field of varying intensity, namely, the earth's magnetic field, yet no correction seems to be applied to allow for this variation in the physical conditions in which the experiments are carried out, or in any other which may be present

Vrkljan has shown (*Zeits für Phys*, vol 63, pp 688 691, 1930) that a decrease in the velocity of light is not in contradiction with the general theory of relativity Certainly it is time that the constancy of this velocity should be established beyond doubt on experimental evidence, instead of merely postulated theoretically

The relatively large error of this new determination prevents it from deciding the question A redetermination of the 'constant' by Michelson would settle it once for all

M E J Gheury de Bray

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Mar 8

Hydrolysis of Acetone in Ultra-Violet Light

In the course of our investigations on the hydrolysis of acetone in ultra violet light, we have measured the effect of the variation of light intensity on this reaction and found a direct proportionality between incident light intensity and reaction velocity Two sets of experiments were carried out, in one of which the intensity was varied by means of a rotating sector and in the other by using diaphragms of different apertures The results, in both cases, give a fairly constant value of the ratio, change/intensity The detailed results of these experiments and their discussion will be published shortly elsewhere

We have further observed that when aqueous solutions of acetone are exposed in closed plane-walled quartz vessels to the full light of a quartz mercury lamp, as well as acetic acid, formaldehyde is formed in quantities sufficient to be detected and estimated colorimetrically Bowen and Watts [1] could not detect any other product except acetic acid under similar conditions In our opinion, the low quantum efficiency (0 2) found by these investigators for this reaction may be partly due to the formation of formaldehyde Experiments to confirm this idea and re determine the quantum efficiency are proceeding and will be reported in due course

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N A Taher

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[1] *Jour Chem Soc*, 129, 1611 1926

Measurement of the Electrical Conductivity of Electrolytes

In Nature of Mar 21, p 441, M Lecomte du Nouy outlines improvements in the method commonly used to measure the electrical conductivity of electrolytes We are particularly interested in this communication, and think it may be worth while to record that we are making a series of such determinations on solutions of phenol in water, using these modifications, but with the further refinement of a Wagner earthing device We hope to publish results shortly

O Rhys Howell
C Handford

College of Technology,
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Mar 24

Red Snow in Persia

On several occasions I have observed 'red snow' on the mountains in Bakhtiari country, south west Persia It usually occurs in patches a couple of yards wide and a score of yards long, lying with normal white snow To day (Feb 14), however, the phenomenon occurred on an entirely different scale a whole mountain side being covered with 'red snow' Two days ago, a heavy fall of snow occurred, lying down to about 6000 ft above the sea level Yesterday was mild and misty, while to day was misty in the morning but clear in the afternoon The mist cleared away from above downwards and had dispersed above 5500 ft above sea level by 10 A M There were a few cloud pennants to be seen infrequently tailing from the higher peaks

Kuh i Javanbin (10,000 ft) and Kuh i Shirgun (9500 ft) are the two mountains on which the 'red snow' was seen Both are smooth topped ridges running north west and south east The south west flank of each is a dip slope of Cretaceous limestone now snow-clad An irregularity at the south east end of Shirgun has produced an extensive facet facing directly

south Viewed at 10 A M, this facet, of the order of 1000 ft high and 2500 ft broad at its base, and situated above the 8000 contour, appeared to be coloured light orange-pink and contrasted strongly with the pure white of the snow on the rest of the south west flank of Shirgun and Javanbin By 3 P M the pink colour had spread all along the south west slope of Shirgun, a matter of 4 miles, and Javanbin was coloured on its lower slopes although the top 1000 ft remained white By this time the original south facing facet of Shirgun was mottled pink and white

The phenomenon of 'red snow' is well known to the tribesmen, who associate the colour with rapid thawing of the snow in the early spring

J V HARRISON

Chulbar, Feb 14

Forestry Research

THE articles in NATURE of Feb 21 and 28, reviewing the work of the Forestry Commission, prompt me to express the wish that they may be perhaps followed by one dealing with certain aspects of forestry research, more especially with recent work bearing on the importance of biological soil factors in relation to tree growth

For example, the significance of mycorrhiza in nutrition, and the urgent need for laboratory research directed to promote control of its formation in new plantations, have long been matters of concern in the Swedish Forestry Service and are becoming so in those of other countries that is, in certain of the North American States In Sweden, a close working alliance between forestry expert and botanical specialist has already produced significant results

In Great Britain and many parts of the Empire the matter is one of special interest and concern in view of the extensive afforestation of non woodland soils and the use of exotic tree species

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Mar 13

DR RAYNER'S letter is of value since it voices a matter which has already been commented upon in previous issues of NATURE The urgent need of a close co operation between the forester and the specialist, whether botanical, zoological, or chemical, should be beyond dispute The working alliance which has come into being in Sweden—foresters, timber companies, and scientific research centres—will well repay study, as also the amalgamation of various interested bodies in New Zealand The great Forest Research Institute at Dehra Dun furnishes a further illustration Whilst, however, these examples merit the closest study, a slavish imitation of any one by Great Britain may result in wasteful expenditure, and also lead to much overlapping of investigation and research work There are instances where the creation of Government research laboratories paid for out of public funds are justified, if not indispensable for the time being In other cases this is not so Research work can be safely left, and with the certainty of better results, to already existing centres, grants being made by the Government department concerned to cover the cost of certain pieces of investigation work required to be undertaken

It is hoped to consider this question in fuller detail in a subsequent number of NATURE Meanwhile Dr Rayner's recent paper, "Mycorrhiza in Relation to Tree Growth" (published in the *Empire Forestry Journal*, vol 9, No 2, 1930), furnishes an illustration in point.

EDITOR OF *NATURE*

β-Transformation

THE theory of radioactive transformation on the basis of wave-mechanics was initiated by Gamow and Condon and Gurney The consequences have been worked out in detail by Born [1] and Kudar [2] But Heisenberg's objection to the construction of particles out of packets of Schrödinger waves, that they tend to spread out in course of time, has not yet been met

It would be interesting to consider the chances of α and β particles being emitted from the nucleus as such Restricting ourselves here to β radiation and taking into account the relativity variation of mass, it is easily verified that the acceleration (or deceleration) of a fast electron due to the same force is $(1-v^2/c^2)^{3/2}$ of its Newtonian value The electron can, therefore, overcome a higher obstacle under relativity mechanics than under the Newtonian

If E is the total energy of particles inside the nucleus, E' is the minimum energy which enables an electron to jump over the potential barrier, N' is the number of particles inside the nucleus possessing the energy E or more, and N the total number, we see that the radio active properties would depend upon the number N' Using Fermi Dirac statistics, we find

$\dfrac{dN}{dT'}$ always positive and

$$\frac{dN'}{dT'} = \text{const}\left\{\frac{E'T}{e^{\alpha+E'/kT}+1} + \frac{E'}{T'} - \frac{\partial E'}{\partial T} + \frac{3}{2}\int_E^\infty \frac{E^{1/2}dE}{e^{\alpha+E/kT}+1}\right\}$$

Thus N always increases with T' (the temperature inside the nucleus), and, subject to a certain restriction radioactive properties are a direct consequence of increasing atomic numbers More definite conclusions depend on precise knowledge, which is at present lacking, of the potential barrier

B M SEN

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Feb 10

[1] *Zeit f Phys*, Bd 58, 306 1929

[2] *Zeit f Phys*, Bd 53, 61, 95, 166 1929 Bd 54 297 1929

The Swimming of Cuttlefish

IN NATURE of June 14, 1930, p 893, F S Russell and G A Steven publish some observations on the movements of *Sepia officinalis*, special attention being given to the part played by the siphon These researches are a confirmation of what was seen by me so long ago as 1912 (*Internationale Monatsschrift für Anatomie und Physiologie*, Bd 39, 1912) and clearly explained in Figs 33 and 34 of my paper (p 129)

OSVALDO POLIMANTI

Istituto di Fisiologia,
R Università di Perugia

WE are indebted to Prof Polimanti for directing our attention to his previously published observations on the swimming of cuttlefish We have not access to the journal in which his work was published, so, unfortunately, have not at the time of writing been able to read it We felt that so obvious a feature in the swimming of the cuttlefish must have been seen before, being unable to find any reference to it, we published an account in the hopes that the information might eventually find its way into English text books, in which the use of the siphon in cuttlefish swimming is given as only for backward darting

F S RUSSELL
G A STEVEN

Forests, Climate, Erosion, and Inundations

FOR centuries a popular belief has existed that forests induce or attract rain With the progress made in the conservation of the forest on carefully prescribed plans of management, the forester took a hand in the controversy which, with the diminution of the area of forest in the more populous parts of Europe, gradually arose round this matter A considerable literature is devoted to the problem of the influence of forests on rainfall and other forms of atmospheric precipitation Until recently the opinions held and the arguments advanced for and against the effects of the forest on climate have been more or less one-sided and based to a great extent on generalisations

During the last few years this important matter has entered on a new and most promising stage in its history On the subject of the general question of forests and rainfall, etc, two papers representing the opposite opinions held in this matter have been published, the one, "Forests and Water in the Light of Scientific Investigation", by R Zon, of the U S Department of Agriculture (1927), and the other, "The Influence of Forests on Rainfall and Run-off", read by Dr C E P Brooks before the Royal Meteorological Society (1927) Since these two papers, several other important contributions to this subject have appeared In 1929 Mr B O Coventry published a paper on "Denudation of the Punjab Hills" which was reviewed in NATURE of Feb 1, 1930 In the same year a Kenya Forest Department pamphlet appeared entitled "The Influence of Forests on Climate and Water Supply in Kenya", by J W Nicholson (of the Indian Forest Service, now Forest Adviser to the Governments of Kenya and Uganda) and A Walter, Director, British East African Meteorological Service

Previously to Mr Coventry's report, Mr L B Holland, of the Indian Forest Service, had been specially deputed by his Government to make a tour of inspection in the outer hills of the Punjab in 1927 and 1928, his report on the matter ("A Report on Denudation and Erosion in the Low Hills of the Punjab") being published in 1928 At the Punjab Engineering Congress, 1930, held in Lahore, a paper entitled "Erosion in the Punjab Himalaya and its Probable Effect on Water Supplies" was submitted to the Congress by Messrs L B Holland and H M Glover, the latter also of the Indian Forest Service The two latter examples from Kenya and the Punjab are of high interest, since in one case we have at length the necessary association and collaboration of the forestry expert with the meteorologist, whilst in the other an equally important association, where great irrigation works depend entirely upon the permanence of the water supplies, of the forest and irrigation officers

Finally, in *Matériaux pour l'etude des calamités* (No 23, No 3, 1930), issued by the Société de Géographie de Genève under the auspices of the Committee of the International Red Cross and the League of Red Cross Societies, a paper appears, "Les Forêts et les inondations", by MM Delville et J Delévoie At first sight it appeared a matter for surprise to find forestry matters being taken up by the Red Cross But the reason soon became obvious It was one of the most serious effects of erosion, inundations and their often appalling catastrophic effects on the populations in the lower hills and plains, which proved the point of interest to the Red Cross Societies

It may be maintained without fear of contradiction, by those possessing any knowledge of this complicated question of forests, climate, erosion, and inundation, all of which are covered in the papers above mentioned, that the latter in their several ways have made a valuable contribution to our knowledge They mark a distinct step forward in the direction of possible practical results in coping with the several evils resulting from man's ignorant action upsetting Nature's balance between the forests, water supplies, and unforested lands In the present article, more than a brief analysis of these papers is impossible their close study will well repay those interested in these questions, as also those responsible, from the positions they hold, for checking further destruction and undertaking remedial measures to minimise the harm already resulting from ignorance or vandalism

The present position of the controversy on forests and rainfall is well summed up in the Kenya pamphlet by Nicholson and Walter R Zon, the American authority, holds to the belief that forests induce rain, and that the most important influence of forests is their capacity for regulating the flow of surface water, and consequently the streams issuing below them Zon has collected and puts forward to support his views a large number of data and observations, the value of which is fully recognised by the Kenya authors, although they believe that, as also in the case of Dr Brooks, data contradictory to the theories of these two are ignored, whilst unsupported generalisations put forward will not bear scientific analysis Brooks holds the point of view opposite to that of Zon, and his treatment of the matter is on the more scientific plane, though generalisations also appear

As most forest officers who have given thought to and had any practical experience of the problems involved are aware, it is due to the fact that so much theory has been indulged in and so much written that would not bear either scientific analysis or (as, if not more, important) such practical field tests as were feasible, that has led to this question being neglected in the past—in fact, it might even be added, to the question being treated with derision by a certain type of forest officer, by the public, and by the civil authorities The last were only too ready to close their eyes to the damage being done, owing to the outcry which they knew would arise from the people engaged in destroying unchecked the forests which had for so long played their protective part in, as we are now learning, a very varying degree and manner

It is unnecessary to consider here the elementary

ideas upon the direct and indirect benefits of forests from a climatic point of view in different regions of the world Any text-book will afford a summary Zon's and Brooks's publications must be consulted for their full views The pamphlet by Nicholson and Walter is important, since it marks one of the first, it is believed, practical contributions to the possible effects of (*a*) destruction of forests, (*b*) afforestation of certain types of area on the climate, and especially rainfall, in Kenya and Uganda Even if put forward tentatively, they are practical suggestions For example, one of the conclusions arrived at is " that under favourable circumstances mountain forests in East Africa can induce occult precipitation (fog or dew) up to at least 25 per cent of the total annual rainfall " Perhaps the most interesting conclusion of these authors is, however, on the subject of ' instability rain ', to which they correctly assign the importance of a chapter to itself Instability rain is a matter of supreme importance in some parts of the tropics Dr Brooks describes it as due " to the warming up of the surface layer of air to a point at which it is potentially higher than the air above it The potentially light air begins to rise, at first in thin threads which produce scattered cumulus clouds, and finally, if the process continues far enough, in thicker columns which cause cumulo-nimbus clouds with rain and perhaps thunder and hail The potential density of the air depends mainly on its temperature and partly also on its humidity " Nicholson adds a few further remarks to supplement this description " In East Africa instability rain falls on still afternoons usually after bright sunny mornings It is frequently accompanied by thunder and is always very local in its distribution In some parts of Uganda to lessen the contingency of crops failing the natives cultivate two shambas some miles apart from one another Unfortunately the European cannot copy this practice, but where the instability rain is the prevailing form of rainfall he can select a long-shaped in preference to a square shaped farm "

Brooks minimises the possible effects of forests on instability rain It may be accorded, however, to the Kenya authors, as a result of their investigations, that they have advanced good evidence for their present conclusion that " wherever meteorological conditions in East Africa are favourable to the production of instability rain the possibility and quantity of such rain is greatly increased by the presence of forests "

Wind, and its connexion with a general consideration of this question, is dealt with in the Kenya pamphlet, but limits of space preclude further discussion of the interesting data

Allusion has already been made to Mr Coventry's paper on the denudation of the Punjab Hills The report, written as the outcome of an examination made of the lower hills by Mr L B Holland, furnishes evidence that the Punjab Government has at length become alive to the seriousness of the position which disafforestation, excess grazing, and so forth, has brought about over large areas of the lower hills The best known example of the results following the unchecked removal of forest growth on a friable geological formation is the case of the Hoshiapur *chos*, which was being quoted so far back as 1877 Under a mistaken policy, the scrub forest on the hills was apportioned out amongst the villagers With increasing population, increasing demands for fuel, and large calls upon the grazing (owing to the far larger herds now kept, due to the more settled conditions under British Government), the hills were entirely denuded , enormous areas of valuable agricultural land were submerged by the tons of debris brought down through the rapid erosion of the now bare hills, and desolation supervened over part of the area known as the Garden of the Punjab This is well-authenticated history But much devastation of forest, with increasing erosion and denudation, has taken place since, and the position reached is now considered so serious that interference with the water supplies upon which the great Punjab irrigation schemes depend may be a not improbable future contingency The paper by Holland and Glover read at the Punjab Engineering Congress (1930) is an effort to focus the attention of the engineer upon this matter, owing to the serious effect of further unchecked forest clearing in the hills on the water supplies Afforestation is suggested, and the claims of building dams to arrest and catch the water pouring down bare hillsides during rain storms, as against the more natural and stable method of undertaking the same operation by means of afforestation, were discussed

The last paper to which reference has been made is " Les Forêts et les inondations ", by MM Delville et Delévoie This paper is written in the interests of Belgium by the Director General and an inspector of the Forest Service Their analyses of the effects of forests on water flow follow R Zon to a great extent, with whose deductions they fully agree, although they recognise that contradictory opinions are held They refer to the practical experiments on the subject of run-off from forested and bare areas which are being made in Switzerland and in the United States Few dispute the argument that inundations have increased in late years in America, India, Africa, and even in Europe In some cases this increase (18 per cent in the last twelve years in the United States) is directly attributable to disforestation The control work which has been undertaken in Alpine countries in Europe is well known The Japanese are engaged upon large afforestation schemes in Korea, mainly for climatic reasons As a result of their survey of the position, undertaken owing to the serious inundations in Belgium of recent years, the writers of the paper under consideration lay down the following policy for the future " On peut conclure avec la Commission du Conseil supérieur des Forêts, chargée d'une étude sur les inondations, qu'il y a lieu de lutter contre celles-ci

" 1 Par une série de mesures destinées à conserver et à renforcer l'état boisé sur les collines et sur tous les plateaux élevés, dont beaucoup sont encore dénudés

" 2 Par des travaux spéciaux de nature à ralentir la vitesse de l'eau sur tous les ruisseaux à pentes rapide, à allure torrentielle "

The Nature and Scope of Physical Science

II

By Prof HERBERT DINGLE

THE present position of physical science is that a large body of observations have been correlated by the two processes of abstraction and hypothesis Abstraction has led us virtually to a contorted space time, and hypothesis to a scheme of concepts unpicturable by the imagination Both space time and the scheme of concepts, however, by obeying prescribed rules, reproduce the data of observation so that out of pure conceptions, having only a rational meaning, we can evolve, as it were, a very large part of the world of experience This is the great achievement of modern physical science The question that next arises is What is the relation, in the category of reality, however we may define that word, of the world of experience to the connecting world of thought?

The question has been framed and answered by Sir Arthur Eddington and his answer is definite—the conceptual world is symbolic of the world of experience ("The Nature of the Physical World", p xv) But clearly that is not sufficient, otherwise science would be merely a form of art, and there would be no justification for laboriously expressing the obvious in terms of the incomprehensible when any poetaster could give an intelligible symbol of the world with infinitely greater facility Apart from practical considerations, there are, so far as I can see, only two possibilities which can justify such a procedure first, that the conceptual scheme is in some sense truer' than the world of experience, second, that it reveals the existence of a connecting link between the diverse elements of experience The fundamental characteristic of the views of science recently presented by Sir Arthur Eddington and Sir James Jeans is that the former alternative is adopted I venture to suggest that this is a mistake the conceptual world of physics is merely a means of making Nature intelligible to our minds and its laws are not to be interpreted as the truth about Nature

It is impossible here to do more than indicate one argument supporting this statement Since physical conceptions are always changing, any truth they represent must be exceedingly protean in form, on the other hand, the process of correlation of observations goes on continuously, and is, in fact, what directs the changes of conceptions We cannot, therefore, regard the scheme of theoretical physics as telling us anything definitive about Nature, except that Nature appears to be intelligible

An important example of the point at issue is found in the question of determinacy It has recently been found advisable to suppose that there is a kind of indeterminacy in the behaviour of atoms, and this has been interpreted as a recognition of indeterminacy in Nature Such an interpretation seems to subject us again to the error from which we have recently become emancipated We have learned that abstractions (time, space, etc) from phenomena are not to be foisted on atoms, and we immediately celebrate the discovery by foisting the characteristics of atoms on phenomena

There is another example, however, which merits more detailed consideration, namely, the relation of science to measurement Eddington (loc cit, p 275) and Jeans ("The Mysterious Universe", pp 140 141) identify the domain of science with the domain of the measurable, and their great authority has been widely invoked by non scientific thinkers intent on 'putting science in its place' It is usually a very simple matter to decide whether an experience is metrical or non-metrical in character, and a ready solution of many of the difficult questions raised by science is available if we can simply ignore everything that science has attempted to say of non-metrical experiences Artists, theologians, metaphysicians, and moralists are thus enticed into what I believe to be a fool's paradise Not only so, but this false escape from the challenge of science is necessarily accompanied by a real deprivation of its benefits Art and religion have much to gain by a proper use of scientific principles, and the sharp restriction of the domain of science to the metrical elements of experience leaves them the poorer

It is of course obvious that a large part of the data of science is non metrical in character The schoolboy's name for chemistry is 'stinks', not 'balances', and a very appropriate name it is Biologists observe the flight of birds very closely, but they do not trouble to apply the Fitzgerald-Lorentz contraction, not because it is too small to be important but because it has no relation to the *kind* of observation they are interested in It is clear, therefore, that much of the recording and augmentation of our experiences, which is essentially scientific, is not metrical This in itself is sufficient to refute the doctrine in question we need look no further in order to disillusion the non-scientific thinkers referred to above

But this is not the whole of the matter No doubt Jeans and Eddington would admit this readily enough, and still adhere to their opinions For to them observations are just convenient tools for leading us to the truth underlying phenomena it is that truth which they claim is metrical Their doctrine applies not to the collecting of experiences but to their rational correlation, and they would say that when we come to analyse our experiences in order to discover the microscopic scheme of Nature, it is only the metrical elements that we can employ scientifically I observe a cup, for example, and I notice that it is yellow in colour and hard to the touch Those experiences I share with other normal people, and they are not primarily metrical But when they are absorbed into the scientific scheme, it is only the metrical part of them which is used The yellow colour, which I happen to dislike and of which someone else might be very fond, is represented only by a range of

wave-lengths', about which neither of us has any emotions at all The hardness is represented by 'electro-magnetic forces' (or modifications of 'space-time') which are definable by means of equations Through these metrical quantities, all that is scientifically tractable in the yellowness and hardness of the cup is expressed, and the other qualities of yellowness and hardness are left over as belonging, according to Eddington, to the extra-scientific domain of experience, or, according to Jeans, so far as I can gather, to the domain of illusions

This idea, as Eddington clearly points out, requires that science is a closed, self-contained system, including all that is metrical in our experiences But it is difficult to see how the existence of this closed system can be established Even in the metrical part of our experiences there are phenomena which lie outside it Take motion, for example The system includes the motion of a comet, but it does not include the motion of a fly We need consider none of the non-metrical aspects of the fly, but only its motion as a piece of matter The matter is made up of protons and electrons, formed into atoms indistinguishable from those of the comet, and its motion can be described completely in terms of space and time Nevertheless, the motion of the fly is essentially of a different character from that of the comet, it cannot be included within the closed system of metrical physics Although itself metrical, we can make nothing intelligible out of it unless we associate it with something non metrical, which we call 'life', and if anyone thinks that motions associated with life are so entirely incalculable as to be outside science, he should reflect for a moment on the significance of a fly-paper

The fact is that science is fitted to deal with all experiences which are common to all normal people Such of these experiences as are metrical in character are largely—but, as we have just seen, not entirely—susceptible to correlation by the present scheme of physics The others appear to be amenable only to conceptions which are individually different but ultimately of the same character For these experiences also we employ abstractions and hypotheses The abstraction of space time is irrelevant, so we leave it in the phenomena and instead take out such concepts as life, mind, will These are just as truly abstractions as are space and time the 'I' of psychology is as valid a scientific idea as the 'i' of mathematics, and has perhaps still more right to be called an imaginary quantity, for it can at least be imagined Similarly, we employ hypotheses The hypotheses of protons and electrons are irrelevant, so we conjure up such ideas as organic evolution and subconsciousness We observe and we correlate by the same methods as those employed in physics, and to a certain extent we can predict events In every respect our treatment of these experiences has the same character as that of the metrical experiences It appears to be an arbitrary and extremely inconvenient use of language to call the one treatment scientific and the other not

Eddington gives an admirable example (loc cit, pp 251-252) of the supposed limitation of science to measurement He describes an imaginary examination question in which an elephant is assumed to slide down a grassy hillside and it is required to find the time of descent He points out that in solving the problem we do not consider the elephant but merely its mass, namely, 2 tons Similarly, the hillside is represented by a slope of 60° and a coefficient of friction Thus the poetry fades out of the problem and only 'pointer readings' are left

Now the whole secret of the matter is in the object of the inquiry, which is mentioned as a sort of after thought "The question presumably was to find the time of descent of the elephant" Naturally, since the time of descent is essentially a metrical quality, we should expect the relevant parts of the data to be metrical in character But suppose the further question is put "To find the damage done to the elephant" "Two tons" is of no use now, the living, struggling, trumpeting animal must be reckoned with We can do without a knowledge of the slope of the hill, and the coefficient of friction 'leaves us cold' As before, the poetry fades out of the problem, and it takes the metrical elements with it, but there is still something left, and that something is scientific in character It involves such things as abrasions and broken limbs, it is approachable with chloroform and X rays, the problem requires a knowledge of the anatomical structure and physiological processes of elephants—that is, scientific knowledge, and the answer can be stated in scientific terms conveying the same meaning to all normal people

The division of common experience into metrical and non-metrical parts, of which only the former can be dealt with scientifically, therefore appears too simple The whole of common experience is open to scientific treatment, part of that which is metrical is included in the physical scheme, and the remainder, together with the non metrical elements, must be placed in a different scientific category—or perhaps more than one such category Even this does not exhaust the potentialities of science, for it has an influence outside its own proper sphere, namely, among those experiences which are peculiar to the individual Such experiences are not in themselves subject to scientific treatment but, by virtue of a parallelism which exists between them and experiences which are so subject, they cannot be considered as if they were altogether independent of science, or, rather, if we do so consider them, we are closing our minds to much relevant information It is common knowledge that a man's temper, which is outside the scope of science, shows a close relation with the condition of his digestion, which is very largely, at least, susceptible to scientific treatment

This point, though sufficiently obvious, is widely overlooked It is frequently supposed that by defining the field of science we define its influence The former problem is difficult enough but not insuperable the latter is not likely to be solved in our day

Obituary

MR SPENCER LE M MOORE

MR SPENCER LE MARCHANT MOORE, who died on Mar 14 last at the age of eighty years, joined the staff of the Herbarium at the Royal Gardens, Kew, in 1872, on leaving University College, where he gained the gold medal for botany Few young men have had the opportunity of training in so brilliant a school of systematists as Kew then offered Joseph Hooker was director, Daniel Oliver was in charge of the herbarium with J G Baker as his second, and George Bentham was in daily attendance, cooperating with Hooker on the "Genera Plantarum", the greatest classic of plant taxonomy Moore, who was about twenty one years of age, quickly got to work Between 1875 and 1880 he contributed a number of papers to the *Journal of Botany*, partly in co operation with J G Baker, on collections from North China, tropical Africa, and the Mascarene Islands, and on various genera of Orchids and Acanthaceæ In 1877 appeared, in the same *Journal*, the first of his "Alabastra diversa", a series of descriptions and critical notes bearing on genera and species of flowering plants, which, except for a long break from 1880 to 1899, continued almost yearly up to 1929 From 1877 until 1879 he assisted Henry Trimen in the editorship of the *Journal*

Then came a break An unfortunate difference with Hooker led to Moore's resignation in 1880, and an attempt to obtain a post in the Department of Botany of the British Museum was unsuccessful During the ten years that followed, he turned his attention to plant cytology and a succession of papers entitled "Studies in Vegetable Biology" appeared under his name in the *Journal* of the Linnean Society They dealt with such subjects as continuity of protoplasm, effect of light on protoplasmic movement, and the nature of callus But he was a lone worker, his papers attracted little attention, and one feels that he had got out of his proper element However, in 1891 came an opportunity He joined as botanist a prospecting expedition to Matto Grosso, Brazil, and returned with a large collection, the elaboration of which, comprising many new genera and species, and a general account of the vegetation of the district, filled 250 pages of a volume of the Linnean Society s *Transactions* It was distinctly his *magnum opus* In 1894–96, he joined a small gold-seeking expedition to the interior of Western Australia, and his "Botanical Results and Observations on the Nature and Relations of the Desert Flora", also published by the Linnean Society, was a valuable contribution to the botany of a little known area

Then in 1898, Moore came to anchor in the Department of Botany of the British Museum as an 'unofficial assistant', and from then until the time of his death worked steadily on the Museum collections His interests lay chiefly with the families Compositæ and Acanthaceæ and the Australian flora But there were few families of Dicotyledons of which he had not a working knowledge, and the results of his work appeared in a continuous stream of critical descriptive papers In the preparation of accounts of important collections received at the Museum, the elaboration of the gamopetalous and apetalous Dicotyledons generally fell to his share Since William Fawcett's death in 1926 he had been helping towards the completion of the "Flora of Jamaica" He had finished the Compositæ and the greater part of the Rubiaceæ, when a paralytic stroke abruptly ended his work, in his eighty first year

Few botanists have left such a full record of critical taxonomic spade work, or have accumulated so extensive a knowledge of the minutiæ of the genera and species of flowering plants Spencer Moore's kindly personality and his invaluable help, always ungrudgingly given, will be greatly missed by his former colleagues at the Museum A B RENDLE

WE regret to record the death on Dec 19, at the age of eighty-nine years, of Dr C Willgerodt, extra-ordinary professor of chemistry at the University of Freiburg-im-Breisgau From the *Chemiker-Zeitung* we learn the following particulars of his career Born at Harlingerodt in 1841, the son of a farmer, Willgerodt was trained as a teacher and spent some years teaching in an elementary school before turning his attention to scientific work At the Polytechnic at Brunswick, he began to study zoology, but in his twenty-eighth year he moved to Berlin, where, under the inspiring influence of A W von Hofmann, he devoted his whole time to chemistry Two years later he accepted a post as chemist in a colour factory at Elberfeld, and shortly afterwards he became manager of a factory at Opladen Feeling, however, a desire for further study, he gave up his post and entered the University of Freiburg, where, after graduation, he was appointed to the teaching staff Willgerodt remained at Freiburg for the remainder of his life In 1896 he was appointed director of the Technological Institute, and in 1915 extraordinary professor of inorganic chemistry and technology Willgerodt published numerous original papers on organic chemistry, the best known of which deal with the interaction of chloroform, acetone, and caustic alkalis and with the iodoso- and iodoxy-derivatives of benzene

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WE regret to announce the following deaths

Dr J C Hemmeter, professor of physiology and clinical medicine in the University of Maryland, known for his work on the physiology and pathology of the intestines, on Feb 25, aged sixty-seven years

Mr J G Millais, who was the author of many books on natural history and sport and was known for his excellent animal paintings, on Mar 24, aged sixty six years

Mr P P Quayle, physicist to the Phillips Cartridge Company of America and formerly an assistant in the Bureau of Standards, who was a recognised authority on ballistics, on Feb 21

Mr A J Turner, principal of the Victoria Jubilee Technical Institute, Matunga, Bombay, author of a number of papers on chemistry, on Mar 15, aged fifty six years

News and Views.

Presidents of the Chemical Society, in their annual addresses, customarily exercise choice of subject between the affairs of the society and matters of purely scientific interest. Prof. J. F. Thorpe, who was this year in the unique position of presiding for the third time in succession over the annual general meeting, divided his address, delivered on Mar. 26, into two parts. In the first part he commented on the Society's progress during the decade in which he has been in intimate touch with its work as treasurer and as president; in the second, which was not delivered at the meeting but will be published in the *Journal*, he will discuss the results obtained at the Imperial College of Science and Technology in researches on the chemistry of the glutaconic acids and on the modified strain theory of carbon ring formation. The retrospect dealt first with the scheme for providing a central building to house various societies connected with mining, metallurgy, and chemistry, and referred to the constitution of an association and its registration under Section 19 of the Companies Act, 1929, whereby powers practically equivalent to those usually granted in a Royal Charter have been secured. The association may make no profits, neither may it give any bonus or distribute any money to its members, hence any excess of income over expenditure will lead to a corresponding reduction in the rents paid by the constituent bodies. After careful consideration, a proposal to house the association in the building which has just been erected by Anglo Properties, Ltd., adjacent to the Imperial Chemical Industries building at Millbank, has been rejected, and recourse has been had to the site originally proposed, which is adjacent to Abbey House, Westminster. The sum of £100,000 in cash must be paid by June 24 next to purchase the lease and sub-leases. An appeal to the Treasury has failed to secure assistance, and a similar appeal to the Pilgrim Trust has met with no response.

Abstracts of chemical literature are responsible for an increasingly severe tax on the financial resources of the two societies—the Chemical Society and the Society of Chemical Industry—by which, through the Bureau of Chemical Abstracts, *British Chemical Abstracts* is published. Prof. Thorpe's presidential address referred to the fluctuations in income and expenditure which arise from this and other causes, and advocated the immediate formation of a reserve fund. Since 1921, the membership of the Chemical Society has remained almost constant at about 3900; during the same period receipts from the sale of publications have been nearly doubled, but the cost of publications has largely increased. In advocating co-operation between *British* and *American Chemical Abstracts* in order to minimise waste of money and energy, Prof. Thorpe said that the decennial index afforded an opportunity for collaboration, and suggested as a first measure the quinquennial publication of a joint index giving references to both sets of abstracts. In an alternative scheme, the cost of the abstracts could be spread over a wider field. Such a publication ought to be of interest to all chemists, and ought to be supported by all chemists, yet some 4000 British chemists are not members of either of the two societies which maintain the service. Institutions desiring to avoid the possibility of curtailment of chemical publication, owing to lack of funds, might be willing to pay to the Bureau of Abstracts a sum per head of all those of its members who do not belong either to the Chemical Society or to the Society of Chemical Industry; every member would then be entitled to receive a copy of the *Abstracts*, and the institutions could have the right to appoint a representative to serve on the Bureau. Before concluding his address and inviting Dr. M. A. Whiteley to unveil a portrait of the first president, Thomas Graham, Prof. Thorpe referred to the prolongation of the life of the Dyestuffs Act, and emphasised its influence on scientific research.

The Imperial Institute has been relieved of its most pressing financial anxieties by the munificent gift by Mr. Benjamin Drage of £36,000, which is to be paid in the course of the next few years and is to be applied to the maintenance and improvement of the Institute. The offer has been made to the Empire Marketing Board, and has been accepted by its chairman, Mr. J. H. Thomas. The Imperial Institute was greatly aided by the annual donation of £5000 by the late Lord Cowdray; the cessation of that contribution and the financial embarrassment of some of the leading supporters among the Overseas Dominions have recently threatened some of the work of the Institute. Mr. Drage's gift will assure its development. The Institute has recently held an exhibition explanatory of the mineral resources of the British Empire, which has shown a happy combination of picturesque dioramas that illustrate graphically the mining operations, collections of the ores and minerals, and statistical diagrams of Imperial and world production and reserves. Mr. Drage has made his noble contribution from his realisation of the value of the Imperial Institute as a national centre for education in the economic resources of the Empire. Sir William Furse is to be congratulated on the growth of public confidence in the usefulness of the Institute, of which Mr. Drage's donation is striking evidence.

In his Friday evening discourse delivered at the Royal Institution on Mar. 27, Lord Rutherford discussed helium and its properties. He opened with a résumé of the dramatic history of the discovery of this element. In 1903 Ramsay and Soddy found that helium was produced by the transformation of radium and, as a result of a series of researches, Rutherford showed that the α-particles which are ejected with great velocity from radioactive atoms were identical with helium nuclei. It is probable that the greater part, if not all, of the helium found in the earth and in the natural gases escaping from the earth owes its origin to the α-particles expelled from the radioactive elements during their transformation in the earth's crust. It now seems clear that the helium nucleus of resultant charge 2 is remarkably stable

and is in some way built up by the combination of 4 protons and 2 electrons The loss of mass in this combination shows that a very large amount of energy, probably in the form of penetrating gamma rays, is emitted during the process It can be calculated that the energy released in the formation of one pound of helium from hydrogen corresponds to the energy liberated in the complete combustion of 10,000 tons of coal There can be no doubt that helium is formed from hydrogen under some, as yet unknown, conditions in the stellar system However, it has not yet been found possible to produce helium from hydrogen under laboratory conditions

IN 1914, Lord Rutherford continued, Sir Richard Threlfall suggested to the Board of Inventions of the Admiralty that, on account of its lightness and non inflammability, helium might prove of great service for balloons and airships Prof J C McLennan of the University of Toronto, was asked to initiate experiments to see whether helium could be separated in quantity from the natural gases escaping from the earth in certain districts of Canada which were known to contain about one per cent of helium by volume Arrangements were made on a semi commercial scale to purify the helium by liquefying the methane and other gases present The impure helium was concentrated in the non liquefying portion In this way, many thousands of cubic feet of helium were prepared and transported in cylinders at high pressure About the same time, the Bureau of Mines of the U S A began similar experiments on a large scale, using the natural gases of Texas which were rich in helium Large quantities of helium were separated by liquefaction methods and the cost of the helium was found to be sufficiently low to use it in airships in the place of hydrogen The commercial prospects of the use of helium in airships and other purposes has led to a search for rich concentrations of helium While most natural gases contain less than one per cent of helium, a rich mixture has been recently found in Colorado by boring, which contains more than 7 per cent of helium by volume A plant has been installed which deals with about 600,000 cubic feet of gas per day This should give an annual production of helium of 12 million cubic feet It may be possible that similar rich concentrations may be found on the eastern slopes of the Rocky Mountains in Canada A small gas field was found a few years ago not far from Toronto which had a content of 0 8 per cent helium The rights of these wells have been secured for the University of Toronto in order to have an ample supply of helium for cryogenic experiments in its laboratories

MEMBERS of university staffs are familiar with the inconvenience which results when summaries of theses and dissertations prepared under their supervision or under that of their colleagues are not made and so kept as to be readily accessible Such a collection of abstracts with particulars of publications by members of the University of Leeds, for the session 1929–1930, has recently been published Besides proving a useful reference book within the University, it should be welcomed elsewhere as a demonstration of the manner in which one of the primary functions of a university—the acquisition of new knowledge—is being performed The pamphlet of fifty four pages covers the work done in the faculties of arts, science, medicine, and technology One of the theses describes the results of a topographical study undertaken in order to test the historicity of a group of Icelandic sagas, another concerns the phonology of the old Northumbrian texts The chemical section contains abstracts of theses on such varied subjects as the atomic weight of silicon, the molecular weight of carbon monoxide, aromatic substitution, and catalytic activity Other work carried out included studies on tobacco mosaic, the growth of *Pinus sylvestris*, biochemical oxidation, the chemical aspects of immunity, experimental carcinogenesis the behaviour of electrons, the properties of reinforced concrete beams, the ventilating properties of fabrics, the physico chemical properties of wool fat, the preparation of phthalazine derivatives, and the emission of infra red radiation during gaseous explosion

WE have, from time to time, directed attention, in our columns devoted to "Research Items", to the publications of the Bernice P Bishop Museum of Honolulu of which the primary object is the elucidation of the ethnological problems of the Pacific For some years the museum has added very considerably to our detailed knowledge of the cultures and physical characters of the inhabitants of Polynesia by the publication of the results of the Bayard Dominick Expedition Much of this material is still under examination, while other studies are forthcoming In the meantime, an interesting and intentionally provocative analysis by E S Craighill Handy ("The Problem of Polynesian Origins", *Occasional Papers*, No 8, Bernice P Bishop Museum) offers a suggestion on the complicated question of Polynesian Asiatic relationships We will not attempt here to follow Mr Handy in the details of his argument, in which he traces the various cultural and ethnical influences from Asia which have penetrated Polynesia in prehistoric, Brahmanical, and Buddhist times, but Mr Handy's views on the means by which they were carried to Polynesia are interesting He suggests that the habit of thinking of Polynesian migrations in canoes should be abandoned Almost certainly, the later Malaysians and Asiatics started their voyages, which were probably accidental, in ships The effective agent was the strong current which runs between Luzon and Formosa, so strong that "any sailing ship sucked into it is flung out towards Micronesia" It may not be without interest to recall that the late Sir Henry Howorth, shortly before his death, suggested the derivation of certain cultural elements in Polynesia from Tibet, the casual castaway ship being made accountable for their introduction into Polynesia

PROF ELLIOT SMITH'S Henderson Trust Lecture on "The Significance of Peking Man" (Oliver and Boyd, pp 20, 6*d*), from which we published extracts in NATURE, Feb 7, p 202, pays a well deserved tribute

to the vision and perseverance of Dr Andersson and Dr Davidson Black, by which the existence of early man in China has been established Dr Black's courageous identification of a new human genus on the evidence of the tooth discovered by Dr Bohlin at Chou Kou Tien in 1927 is now fully vindicated Prof Elliot Smith's survey of the course of events, from the first tentative suggestion of the human or anthropoid character of the tooth bought in Peking in 1903, leading up to the final discoveries, is a valuable record for the future historian of scientific discovery Not the least of its merits is the credit given the Chinese authorities for their enlightened support—a support which would, no doubt, have been even more helpful had it not been for the unfortunate course of political events In the circumstances, it was to be expected that the actual specimens should remain in Peking, and that those who wish to study them at first hand must visit China The excellent series of photographs, however, with which Prof Elliot Smith has illustrated his lecture in its published form, gives the reader an opportunity of judging for himself its many remarkable features Among these, the most striking is, perhaps, the remarkable thickness of the walls of the skull as compared with those of Piltdown man, to which the author refers A comparative series of jaws brings out the resemblance between those found at Chou Kou Tien in 1927 and the chimpanzoid jaw of Piltdown As Prof Elliot Smith says, these jaws have now settled a controversy which had lasted for sixteen years

ONE of the chief desiderata of the Zoological Department of the British Museum (Natural History) has recently been supplied by a gift from His Highness the Nawab Sahib of Junagadh of complete male and female specimens of the Indian lion the specimens comprising perfect skins, skulls, and skeletons of two adult animals The skins have been placed in the study collection The Department of Entomology of the Museum has been fortunate in securing the collection of Hesperiidæ (Skipper butterflies) formed by M René Oberthur, of Rennes, consisting approximately of 60,000 specimens from all parts of the world The bulk of the present acquisition was originally part of the great collection of butterflies formed by the late M Charles Oberthur, the greater portion of which, amounting to nearly 800,000 specimens, came into the possession of the Museum in 1897 But to this section of his brother's collection M René Oberthur was able to add, after he had acquired it, the collection of Hesperiidæ formed by M Mabille, who was for many years the leading authority on the group The Department of Geology has received four specimens of the primitive ichthyosaur, *Mixosaurus*, found in the Middle Trias of Edge Island by Mr N L Falcon during an expedition to Spitsbergen in 1927 Two specimens are parts of jaws, another is part of a limb, but the fourth is the almost entire vertebral column, about five feet long The condition of the vertebræ is excellent, and all the neural spines are preserved and clearly indicate the presence of a small tail fin Miss A Lorrain Smith has presented to the Department of Botany 646 drawings of fungi, lichens, and Mycetozoa made by John Templeton (1766–1825), a well known Irish botanist The drawings were given to Miss Lorrain Smith by Dr Howard Kelly, of the United States, and his letter of gift, stating that the collection "should return home, where it can be studied and where it will serve to bring more credit to its author" than would be possible in the United States, is included

IN modern practice, the heat developed in large electric machines and devices limits the load they can carry and therefore their rating Elaborate methods of keeping them cool are adopted and they are sometimes placed in the open air In Great Britain there are many outdoor substations, and this practice is rapidly increasing Another interesting trend of development is to put them in various kinds of gases and liquids so as to facilitate their cooling Transformer coils, for example, are often placed in nitrogen and rotating machinery in hydrogen Many kinds of switchgear are placed in oil or gum In the *Westinghouse International* for January, a 9375 kilovolt ampere turbo generator is described, the rotor of which has been running successfully in hydrogen for six months, despite the fact that it has a projecting shaft It is common practice to run synchronous condensers which have no projecting shaft in hydrogen It has been found experimentally that using hydrogen instead of air increases the rating of the machine by at least 25 per cent In addition, the efficiency is found to be 1 per cent greater, also, there is no need to guard against damage being done to the insulation by effects due to corona discharges Since the machine is hermetically sealed, it can be placed out of doors The hydrogen pressure is kept slightly above the atmospheric pressure, so that the leakage, which tests show to be extremely small, is outwards In case of any abnormal conditions occurring, automatic signals attract the operator's attention

THE Council of the London Mathematical Society has decided on an extension of the scheme, which was started six years ago, of devoting two of the meetings in each session to a lecture It has now been decided to devote an occasional meeting to a set discussion on recent advances in a selected branch of mathematics The first of these discussions will take place at the meeting on April 23 at 5 P.M. at Burlington House The discussion, which will be on "Recent Work in the Additive Theory of Numbers", will be opened by Prof G H Hardy, he will be followed by Mr E Maitland Wright on "New Partition Problems", Mr A E Ingham on "The Method of Brun and the Theorem of Schnirelmann", and Dr A E Western on "Computative Work connected with Waring's Problem" It is hoped that Prof L J Mordell, Mr S D Chowla, Dr T Estermann, and Prof J E Littlewood will also take part in the discussion The second lecture of the session will be given by Prof J E Lennard-Jones at the meeting on May 14 Members of other scientific societies who may be interested are invited to attend these meetings

In recent years, many aquatic birds have shown a new spirit of colonisation in Great Britain The spread of more than half a dozen species of wild ducks, especially in Scotland, has been remarkable Sharing with the ducks in this great advance movement, and we refer again particularly to Scotland, has been the great crested grebe But there is evidence that the breeding range of this species is altering in England also, and, if this be so, the sooner exact information about the past and present detailed distribution is collected the better For with such a firm basis of fact, future movements may be recorded with accuracy and perhaps some of the factors concerned in so general a movement may be elucidated Naturalists, therefore, would be doing good work if they contributed information to the "Great Crested Grebe Enquiry" of T H Harrisson and P A D Hollom The investigation aims at forming a census of great crested grebes for the whole of Great Britain, and is supported by *British Birds* (Feb 1931) Schedules to be filled in with desirable data may be obtained from Mr Harrisson, at Pembroke College, Cambridge

The value of red squill powder in the destruction of rats is becoming increasingly recognised When experiments were carried out in the Zoological Gardens in London some years ago, it was found that the liquid preparation of red squill (a liliaceous plant known also as scilla and sea onion, *Urginea maritima*) was more trustworthy than powder mixtures Since 1923, however, the U S Department of Agriculture has been experimenting with the powdered forms, and it has been found that a powder of maximum toxicity can be obtained by drying the sliced bulbs at a constant temperature of 80° C Thus the greatest difficulty in the use of red squill, irregularity of results, has been overcome, and the poison has become the most widely used against rats in the United States It is greatly in its favour that this rat poison is relatively harmless to human beings and domestic animals, indeed, in field tests, prairie dogs and pocket gophers refused to eat the red squill baits and in most cases cats, dogs, chickens, pigeons, and pigs either refused to eat poisoned foods or, having eaten, promptly vomited them One of the authors of the new U S Dept Agriculture *Leaflet* 65, "Red Squill Powder and Rat Control", himself swallowed 15 grain and 40 grain doses of a toxic red squill powder without untoward results

Two recent *Botany Leaflets*, Nos 15 and 16, received from the Field Museum of Natural History, Chicago, appear to be almost models of their kind No 15, on "Spices and Condiments", by James B McNair, whilst full of information, has a wide general appeal, because the history and romance of these plant products are always kept in view Writing for the New World, the author emphasises the fact that most of the spices used by man have had their home in the tropics of Asia, whence they have spread all over the globe, the value of all spices shipped directly to the United States averages about twelve million dollars annually *Leaflet* No 16, "Fifty Common Plant Galls of the Chicago Area", by Carl F Gronemann, is also extremely attractive A brief introduction is well calculated to arouse the reader's interest All the galls described are clearly illustrated, and although their number is so small, probably any Chicago reader could soon find a few of them near his home Interest once thus aroused, plenty of references are supplied to help the reader to further knowledge in a little-studied field It is doubtful whether in strenuous northern America, especially the eastern United States, the amateur naturalist has flourished as he has under English conditions, and these leaflets should do much to encourage the development of the naturalist in the strenuous industrial centre served by the Museum

The National Smoke Abatement Society has issued No 1 of its second volume (23 King Street, Manchester, 1*s* quarterly), which shows how the problem of atmospheric pollution is being handled in different parts of Great Britain New ground is being broken by the West Riding of Yorkshire Regional Smoke Abatement Committee in setting up a scheme for training and certification of stokers and boiler attendants In its first year, candidates from eleven centres are already expected to sit for examination, and there are indications of more next year It is hoped that improved training will raise the status of the fireman, and by more intelligent operation, promote not only efficiency and economy, but also reduce the nuisance which is so great in the textile areas The journal reveals great efforts of smoke abatement reformers, but the difficulty is to secure the active co operation of the smoke producers, both domestic and industrial

The United States National Museum, the expenses of which have been provided by Congress since 1877, cost during the year ending June 30, 1930, a sum of 762,514 dollars, 14,490 dollars above that of the preceding year More than half a million specimens were added to the collections, including a great ball of crystal 12⅞ inches in diameter and weighing 106¾ pounds, believed to be the largest perfect crystal sphere in existence The specimens now covered in the museum catalogues number 12½ millions, of which more than 9 millions belong to the Department of Biology, and 2 millions to Geology The annual attendance remains very high, the visitors approaching the two million mark, and it is remarkable that in the course of four years the annual number of visitors to the Arts and Industries Section, which now stands at 863,000, should have increased by half a million, while other sections show relatively small increases

The United States Geological Survey has republished a general introduction to the Coalfields of the United States and a chapter on the Coalfields of Ohio (*U S Geol Surv Prof Pap* 100), which were first published in 1917. At that time it was planned to publish similar descriptions of the coalfields of the various States, this plan has now been abandoned, but it has been considered worth while to republish the two chapters in question The general description of the coalfields by Mr Campbell occupies some thirty three pages, whilst that of the

coalfields of Ohio by Mr Bownocker occupies some sixty-one pages, for the purposes of the general student of the distribution of the world's coalfields, the former is undoubtedly of far greater importance, and the United States Geological Survey is to be congratulated upon its decision to republish this information and thus render it more readily accessible

THE spontaneous combustion of coal is a source of trouble to those concerned with the winning, transport, and storage of coal At air temperature, oxygen may be absorbed, causing a rise in temperature, but after a time, smouldering begins The Safety in Mines Research Board has issued a report (No 63) of an investigation by H E Newall and F S Sinnatt on the "Propagation of Combustion in Powdered Coal" This smouldering of coal dust can be propagated at temperatures above 130° at a speed which depends on conditions, but can be so low as 5 in per hour It was shown that appreciable quantities of hydrocyanic acid were evolved on combustion at 500°-600°, which suggests the existence of an additional and unsuspected hazard associated with spontaneous combustion

IN the December issue of the *Quarterly Review of Biology* is the fifth annual report on the cost of biological books This deals with the books received during the year 1930 The biological books published by the United States Government stand lowest in the comparative list of prices France continues to produce the cheapest commercially published scientific books, costing on the average, at 0 47 cent per page, less than half as much as those of any other country, while there is a continued increase in the prices of German books, which average 1 82 cents per page, being far above that of any other group except the English American books, in the cost of which (at 1 91 cents per page) are included transportation charges and tariff The cost of English biological books (1 13 cents per page) decreased slightly as compared with 1929

WATSON'S *Microscope Record* for January (No 22) contains useful practical articles on "Microscopical Methods for Mycetozoa", by J M Coon, and on "Cements and Finishes for Microscopical Preparations", by W D Grier C H Oakden continues his notes on early photomicrographers Details are given of contributions by, among others, Fox Talbot (1839), Hogg (1841), and Diamond, the first secretary of the Photographic Society (now the Royal Photographic Society) Draper, who in 1840 made the first astronomical photograph of the moon, between 1851 and 1856 took several daguerreotypes of microscopical objects Donne in 1884 issued an "Atlas d'anatomie microscopique", containing no less than eighty photomicrographs printed from daguerreotype plates etched with hydrochloric acid The plates, being of very soft metal, were useless by the time fifty impressions had been taken This "Atlas" is the first book of photomicrographs published

THE Daniel-Pidgeon award for 1931 of the Geological Society of London has been made to Mr W Q Kennedy, who proposes to investigate certain porphyritic and non-porphyritic basic intrusions of composite character in the Tertiary province of the west of Scotland

AT the annual general meeting of the Ray Society on Mar 20, the following officers were re elected *President* Prof W C M'Intosh, *Treasurer* Sir Sidney F Harmer, *Secretary* Dr W T Calman Mr D J Scourfield was elected a vice president, and Prof F Balfour Browne and Mr Charles Oldham were elected new members of Council It was announced that the first volume of Dr Gurney's monograph on "British Copepoda" is in the press and will form the Ray Society's issue for 1931 The Council appeals for further support to enable the Society to continue its work of publishing natural history books which otherwise would be unlikely to find means of publication

THE Glass Manufacturers' Federation has arranged an exhibition of British glass and glassware to be held in the exhibition hall of Messrs Selfridge and Co, Ltd Oxford Street, London, on April 13-18 Among the ten sections into which the exhibition will be divided are safety and 'health' glass, chemical scientific, laboratory, medical, and machine glassware, gauge glass glass tubing and rods, and neon signs optical glass lenses, and lighthouse glass, electric lamp bulbs for lighting and scientific purposes Among the demonstrations which have been arranged are glass blowing, 'health' glass, invisible rays, and glass eye making

AN exhibition is being held in the Czechoslovak National Museum, Prague, of the works of the great seventeenth century astronomers, Johann Kepler and Tycho Brahe Though neither was a native of Bohemia, each spent the most important and fruitful period of his life in Prague Each, too, was in turn Astronomer Royal to Rudolph II, who made Prague a centre of art and learning Kepler was there during the years 1600 to 1612, and taught at the German university The exhibition contains material drawn from within the borders of Czechoslovakia, especially from the libraries of Strahov Monastery and the University of Prague, the State Observatory, and the private collection of the Fric family

THE preliminary programme of the congress of the Royal Institute of Public Health to be held at Frankfurt on Main on May 19-24, has recently been issued Amongst much information, including a preliminary itinerary, is the list of sectional presidents They are Section (1), State medicine and municipal hygiene, Lord Moynihan and Prof M Taute, Section (2), architecture, housing, and town planning, Prof Patrick Abercrombie and Dr O Weigert, Section (3), industrial hygiene, Viscount Leverhulme and Dr Arthur von Weinberg, Section (4), women and children and the public health, Viscountess Erleigh and Prof H von Mettenheim, Section (5), tuberculosis, Dr David Davies and Prof L Brauer, Section (6), pathology, bacteriology, and biochemistry, Prof Theodore Shennan and Prof W Kolle

IN his presidential address on Mar 22 to the Glasgow Archæological Society, Mr Ludovic Mann described

some recent discoveries in the west of Scotland. Many of the relics were exhibited. A notable find was that of a Roman warrior buried, after cremation, on the Wigtownshire shore, associated with three Roman pottery vessels, two of *terra sigillata*; two iron spearheads; an iron sword; some iron fragments in the nature of plating; a bronze ring; an iron ring containing an intaglio of pale green chalcedony engraved with the figure of a female, robed and holding in her left arm what appears to be a palm branch.

A short handy list (B 7) of second-hand books on botany, herbals and medicinal plants, gardens and gardening, fruits and fruit culture, trees and shrubs, agriculture and husbandry, has been issued by Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1.

Messrs. W. H. Robinson, Ltd., 16 Pall Mall, S.W.1, have just issued a "Catalogue of Rare Books", No. 32. Most of the books listed are of a general character, but there are some of scientific interest, for example the first edition of Malthus's "An Essay on the Principle of Population, as it affects the future improvement of Society"; several volumes of the Hakluyt Society, and a manuscript in 3 vols. of lectures on chemistry by Prof. Joseph Black, of Edinburgh.

Applications are invited for the following appointments, on or before the dates mentioned:—A handicraft instructor at the Anerley Residential School—The Education Officer (S.S.6), County Hall, Westminster Bridge, S.E.1 (April 11). A junior lecturer in commerce in the University of Liverpool—The Registrar, The University, Liverpool (April 13). A lecturer in education in the University of Sheffield—The Registrar, The University, Sheffield (April 18). A junior scientific officer under the directorate of scientific research of the Air Ministry, for research in connexion with electrical equipment, especially with reference to electrical ignition apparatus—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 18). A probationer naturalist on the scientific staff of the Fishery Board for Scotland—The Secretary, Fishery Board for Scotland, 101 George Street, Edinburgh (April 20). An assistant in the Brighton Public Museum with a knowledge of ornithology and taxidermy—The Director, North Gate House, Church Street, Brighton (April 27). An advanced studentship in education in the University of Manchester—The Registrar, The University, Manchester (May 1). An additional assistant pathologist in the Public Health Department of the Shanghai Municipal Council—John Pook and Co., 68 Fenchurch Street, E.C.3.

Our Astronomical Column

Early Images of Pluto on Flagstaff Plates.—*Harvard Card*, No. 148, reports that images of Pluto have been detected on two plates taken at the Lowell Observatory in the spring of 1915. That was the year in which Prof. P. Lowell's "Memoir on the Trans-Neptunian Planet" was published, and it is quite likely that he examined these plates himself; they were presumably taken specially for the search. It is much to be lamented that the images were not detected at the time, as Prof. Lowell would then have been cheered, before his death, by knowledge that his prediction was successful. Incidentally, the number of pre-discovery images of Pluto that were undetected at the time (eleven are now known) emphasises the skill and alertness of Mr. Tombaugh in making the discovery so promptly after inspection of the plates of January 1930. Dr. Bower has corrected the orbit of Pluto by computing the planetary perturbations, and gives the following residuals (Observed—Calculated) for the earliest three positions:

				R.A.	Decl.
1914	Jan.	23	Königstuhl	+2·9″	+0·4″
1915	Mar.	19	Flagstaff	+3·0	−2·7
„	April	7	„	+3·8	4·8

He asks that any observers who possess plates that might contain images of Pluto should send him the dates of exposure; he would then calculate the perturbations and send an accurate position to assist in the search upon the plates. His address is the Students' Observatory, Berkeley, California.

A Very Distant Spiral Nebula.—A *Daily Science Bulletin* issued by Science Service, Washington, D.C., dated Feb. 25, announces that M. L. Humason has photographed with the 100-inch reflector at Mount Wilson the spectrum of a very faint nebula discovered by W. H. Christie; its position in the sky is not stated. The spectrum shows a shift of the lines towards the red, corresponding to a recession of 17,600 km./sec., and an estimated distance of 120 million light years. This is by far the most distant nebula the distance of which can be regarded as 'measured', but it will be remembered that when Dr. Hubble published his determination of the distances of the Andromeda nebula and Messier 33 as nearly a million light years, he estimated that the faintest nebulæ that could be reached with the 100-inch were distant about 150 million light years. The estimate of distance derived from the spectral shift is independent of the view taken as to the reality of the recessional movement. Prof. A. Einstein, the Mount Wilson astronomers, Sir James Jeans, and others regard this movement as only apparent, arising from the properties of the four-dimensional space-time continuum; but Prof. de Sitter (supported to some extent by Sir Arthur Eddington) considers that the recession is really going on. Prof. Einstein is now at Mount Wilson, and naturally he is following this investigation with great interest.

Heights and Diameters of Lunar Craters.—The *B.A.A. Jour.* for January contains a statistical paper by T. L. MacDonald, in which he studies the altitudes of the walls surrounding the craters, measured both from the external plain and from the crater floor, and correlates them with the diameters. Detailed measurements are given for about two hundred formations. The graphs that are given show that the height varies approximately as the square root of the diameter, so that the plotted points lie on a parabola. To a diameter of 84 km. corresponds a height of 4·4 km., and to 24 km. corresponds 2·8 km. Craters in the region between Tycho and the south pole (which the author calls the continental region) are unusually high for their diameter. A drawing of an ideal lunar crater (in which the vertical scale is much larger than the horizontal one) shows that the slope on the inside of the crater walls is much steeper than on the outside.

Research Items.

Folk-memory in Crete—The contents of vol 41, pt 1, of *Folk-Lore* include the presidential address to the Folklore Society by Prof R M Dawkins at the close of his term of office It illustrates the general principles of the evidential value of folk memory in application to a specific area in which it is possible to check tradition by bringing it into relation with historical records There is no popular tradition now alive in Crete which reaches back to Minoan times, and in fact it does not go back earlier than the name Hellen The preservation of place names and, indeed, of the language—a popular form banned by literature and learning—is in itself an effort of folk memory But until recently the name Hellen meant pagan and the place names which preserved a long tradition have been obliterated by recent changes Of Christian history, a memory, if mistaken, is enshrined in the tomb of Caiaphas Of Byzantine history there is little to show One tradition, though false, preserved a record of the voyage of Eudocia in 443 A D, while another, entirely false, related to a Byzantine lady of the ninth century Of the Arab occupation there were no stories, but the story of the Twelve Archons' refers to the Byzantine reorganisation of Cretan society from Constantinople after the reconquest The ballads and legends of Digenis, a hero of the struggle against the Saracens on the Asiatic frontier, are also referred to Byzantium The raids of pirates made considerable impression on the popular mind, and the Venetian supremacy was also remembered, but it is with the Turkish occupation that popular memory really begins, and to it popular tradition and legend predominantly belong

A Ritual Use of Rock Paintings in Tanganyika—In the March issue of *Man*, which is devoted entirely to Africa, Mr A T Culwick describes a ritual at Bahi In certain rock shelters are rock paintings about which Wagogo tradition relates that Wamia, who was driven out by their earliest ancestor Kiman chambogo, and Amankara made them, when they sacrificed cows, using the fat of the victims to make the lines Now, therefore, the Wagogo, although they know nothing of the meaning of the paintings, during a drought go to these rock shelters, which they regard as sacred, and *tambika* there—that is, offer up a special form of sacrifice in which the entrails are taken out of the victim and thrown at the sacred object The fat of the animal is used to brush over the painting, following the lines drawn by Wamia The present Wamia tribe, who are said to have been an offshoot of the Masai, have funeral rites of an unusual type When a distinguished man or woman dies, a rock is *tambika'd* All the elders assemble, bringing with them a black robe, a black sheep, and black cow They drink beer, which they then spit out on the rock The fat of the sacrificed animals is melted and with it a picture of the dead man is drawn on the rock with some of his personal possessions, such as cattle, gourds, pestles and mortar, ornaments, etc The pictures are then covered with branches and all the people of the village are called for a feast and to drink beer After this, the elders pray to the deceased, asking for rain in return for their presents The entrails, with the black robe and some tobacco, are left at the foot of the rock A medicine man is always represented as a snake

Iodine Supply and Goitre—Investigations undertaken in the United States, Switzerland, and New Zealand indicate that there is a correlation between the level of iodine intake and the prevalence of endemic goitre In the same three countries, it is reported that the administration of iodine in goitre areas has been followed by a marked decrease in the incidence of the disease In England, the incidence of goitre among school children aged 13 14 years varies, in rural areas, from 0 4 per cent in Essex to 24 5 per cent in Somerset, and in towns from 0 1 per cent in Middlesbrough to 17 2 per cent in Preston In view of these differences, Dr J B Orr has undertaken a survey of the iodine content of foodstuffs in representative areas (Medical Research Council, *Special Rep Series*, No 154) The substances selected for analysis were soils and pastures, milk and eggs, all from the same farms and fields so far as possible, locally grown cabbages and potatoes, blood from local sheep and their thyroid glands The results obtained are inconclusive The iodine supply, as judged by the content of milk, eggs, and cabbage, is higher in the Scottish area, which is known to be goitre free, than in the English counties, where goitre is to a greater or less extent endemic On the other hand, there is no indication whatever of any definite difference between those areas in England with a low goitre incidence and those reputed to have a high goitre incidence

Life of the Spider A notable contribution to our knowledge of the biology of spiders has been made by Dr P Bonnet (*Bull Soc Nat Hist, Toulouse*, **59**, 237 700, 1930) In seven years, 1598 spiders of ten different species have lived under his care and no less than 522 have been raised from the egg to the adult This has enabled him to show that the number of moults during growth—4 to 22—depends only on the size of the spider, while the time between two moults depends more on the temperature and food supply than on age He describes a complex mechanism for the autotomy of injured limbs and shows that this cannot always be an involuntary reflex act Regenerated limbs require three moults to attain their normal size, the process of such regeneration is also described fully Some of his spiders achieved the regeneration of all eight legs simultaneously

Craniology of the Dog T Marchlewski (*Bull Internat Acad Polon Sci et Lettres*, No 7 8, B 2, 1930) discusses the relationships between the diverse groups of breeds of dogs, and concludes there are three clearly defined types as shown by their skull characters The *Canis leineri* or greyhound group is a uniform group sharply distinct from all other groups of dogs The *C optimæ matris* group is less clearly defined, shows no definite affinities with the greyhound group, and is formed by the narrow headed, long snouted collie type and by another type represented by the Alsatian wolf dog The *C decumanus* type, the primitive hound or gun dog type, has a long cranial region and comparatively high crested skull, narrow cranium and moderately wide forehead, and moderately long facial region This seems to be the type from which have been gradually evolved, with the influence of crosses of the greyhound and the collie type, the highly bred types of pointers

A New Mounting Medium—G D Hanna (*Jour R Micr Soc*, vol 50, pt 4, 1930) describes under the name "Hyrax"—a derivative of naphthalene—a new mounting medium for microscopic preparations of diatoms It is a resin of pale straw colour, its refractive index is 1 82, and it is soluble in benzene, xylol, and some other organic solvents, which are

easily expelled from the mounted preparation, by gentle heat In slides exposed to sunlight, the medium darkens "to about the colour of old balsam", but in those kept in cabinets, the medium remains "practically water white"

Hatching of Insects – E K Sikes and V B Wigglesworth (*Quart Jour Micr Sci*, vol 74, pt 2, 1931) record observations on the hatching spines present on the embryonic cuticle of bugs and lice The mechanism of hatching is described for a flea, the meal worm, a grain moth (*Sitotroga*), *Lucilia*, the bed bug, and a louse (*Polyplax*), and the general mechanism of the hatching of insect eggs is discussed The embryo increases in size very rapidly before hatching by swallowing the amniotic fluid, and thus acquires a better purchase for its operations against the chorion In every case, the force employed to break open the egg appears to be muscular The swallowing of air may also play an important part in the emergence of the larva The authors devote particular attention to the first appearance of air in the tracheæ of the larva This occurs in three different ways —(1) the surface of the larva dries while still in the egg, and the tracheal system fills, before hatching, from the outside air, for example *Ceratophyllus*, *Tenebrio*, (2) the larva at the time of emergence is enclosed in a cuticle which retains a layer of fluid, so that air has access to the tracheæ only when this embryonic cuticle is shed, that is, after hatching, for example *Cimex*, *Polyplax*, (3) the tracheal system fills with gas while the larva is still bathed in the fluid contents of the egg that is, it fills with the gases which were in solution, for example, *Lucilia* and the grain moth It is suggested that the fluid in the tracheæ, which has passed in previously from the tissues, is absorbed by the osmotic pressure of the tissue fluids, and that, since this pressure is increased by muscular activity, air appears earliest in those insects which show the greatest activity while in the egg

Edible and Poisonous Fungi —It is with pleasure that we note the appearance of a third edition of "Edible and Poisonous Fungi" (*Bulletin* No 23, Ministry of Agriculture and Fisheries, London, 1930, 2*s* 6*d*) The volume has always been useful to the country person, giving him an element of security in gathering fungi for food purposes and doing much to eradicate the numerous superstitions which have been built up around poisonous toadstools The present edition has been improved by the substitution of more typical illustrations, and four more common species have been described There is little danger of the non technical mind confusing any of the edible species, with the possible exception of *Amanita rubescens*, which is probably not sufficiently distinct from the poisonous *A muscaria* The descriptions are lucid and a short glossary is given

Microchemical Recognition of Saponin in the Plant — Robert Fischer and his colleagues are developing a new technique for this purpose Their methods and results are described in the *Sitzungsberichte* of the Vienna Academy of Sciences, Abt I, vol 139, 1930, pp 321 354 Essentially the method consists in covering a section with a gelatin solution containing salt, at a definite *p*H, by addition of phosphate buffers, and mixed with defibrinated blood or washed red blood corpuscles before it has set The section must be completely covered by the gelatin, when, if saponin is present and diffuses out of the section, a clear region will be seen to develop around the section owing to its hæmolytic action By the different behaviour of saponins in gelatin at different *p*H, it is claimed that different types of saponin can be recognised Solanin is also recognised by the fact that it is put out of action by cholesterol, if the section is boiled in a solution of this substance, whilst the cholesterol solanin complex is apparently broken up and the solanin again released by treatment with boiling xylol The distribution of saponins in various Caryophyllaceæ and Solanaceæ is examined by these methods

Fossils of the Samana Range —An account of the palæontology and geology of the Samana Range in the North West Frontier Province of India has been prepared by Lieut Col L M Davies and others (*Palæont Indica*, N S, 15, 1-8, 1930) The range consists of a single anticline crossed by two faults The Jurassic is represented by beds which appear to be either Upper Bathonian or Lower Callovian, and perhaps by Upper Jurassic In the Cretaceous there is definite evidence for Neocomian and Albian horizons Lower Eocene beds are well represented and correspond to the Ranikot series The Jurassic and Gault Brachiopods are described by Miss H M Muir Wood, the Albian Echinoids by Miss E D Currie, the Albian Gasteropods and Lamellibranchs by L R Cox, the Neocomian and Albian Ammonoids by L F Spath Of the Lower Eocene fauna, the Foraminifera are described by L M Davies, the corals by Prof J W Gregory, and the Mollusca by L R Cox, who gives an account of the palæo geographical conditions of the period

The Banket of the Witwatersrand An important paper, stimulated by Dr L C Graton's recent advocacy of a hydro thermal origin for the gold deposits of the Rand, was read by Dr L Reinecke at the meeting of the Geological Society of South Africa on Dec 8, 1930, and will appear later in the Society's *Transactions* Dr Reinecke shows that the orientation of the pebble axes, the inclination of cross bedding, the arrangement of the conglomerate lenses, and the thinning and gradual decrease of grade size from north west to south east proves that the Main Reef Leader of the Far East Rand was laid down by currents flowing from the north west, and not, as Graton supposes, by wave action The Witwatersrand system also differs from marine formations in its lack of calcareous members The whole assemblage is shown to resemble in a very remarkable way that of the Siwalik system of northern India The evidence of its having been deposited by streams on the lower piedmont slopes and flood plains of a large river system appears to be quite conclusive Orogenic conditions resembled those which obtained during the deposition of the Siwaliks but the climate was wetter and colder on the Rand than in the sub Himalaya Dr Reinecke also records that he has been unable to find any relation between the distribution of gold in the reef and the folds, faults, or fractures that affect the system or the dykes that have intruded upon it, with the exception that in places certain zones of payability have been displaced by post ore faulting The hydro thermal hypothesis seems to be definitely untenable in the light of the evidence now presented

Quiet-day Magnetic Variation —In a paper in the March number of the *Proceedings of the Royal Society*, Prof S Chapman and Mr J M Stagg present an analysis of the variability of the quiet day diurnal magnetic variation for the stations at Eskdalemuir, Greenwich, Ebro, San Fernando, Batavia, and Mauritius The ranges of the variation change from day to day irregularly, but there is a definite correlation between the changes in different elements and at different stations, the correlation being greater the nearer the stations Very quiet days often occur in sequences of two or more, and there is also a tendency

for abnormalities of range to persist for several days The interpretations which are put upon the results—the labour of obtaining which has been, naturally, extremely heavy—is that there is both a world wide cause governing the changes, this being probably the conductivity of an upper atmospheric layer due to a solar ionising agency, and a regional cause, which may be a local irregular distribution of temperature and density in the upper atmosphere

Discontinuous Sorption by Porous Solids—During the past few years, considerable evidence has been collected by Prof A J Allmand to show that there is an essential discontinuity in the process of sorption of vapours by charcoal The isothermals (vapour pressure plotted against quantity of vapour which has passed into a condensed phase in conjunction with the absorbing body) show many small breaks which are considered not to be due to experimental error The present position with regard to this important question is reviewed by Prof Allmand and Mr Burrage in the March number of the *Proceedings of the Royal Society*, and in a very full examination of their own results in relation to those of other workers, it is concluded that no discrepancies arise Scrutiny of results published by others indeed shows some comparable inflections of curves Some new results are also presented in this paper for silica gel, which also contain evidence for discontinuity, and it is pointed out that there are theoretical reasons for expecting that it should occur The authors remark that the experimental results make it even clearer than before that only work with plane or relatively plane surfaces is likely to yield information of value about the fundamental adsorption process, a complex porous sorbent like charcoal being inapplicable for this purpose

Impact of Spheres—A series of investigations has recently been carried out by Dr J P Andrews on the impact of spheres (*Proc Phys Soc*, Jan 1, 1931 and earlier papers) Interest in the problems of impact dates back at least as far as Newton, who gave his law of restitution in the Scholium to his Laws of Motion Actual theories of impact centre for the most part round either the wave theory of Saint Venant or the pseudo statical theory of Hertz The subject has in the past aroused the interest of numerous investigators, few problems have the wide appeal that this possesses alike for the physicist the engineer, and the mathematician The most widely known of these investigations is undoubtedly the famous 'guillotine' series carried out by P G Tait and commemorated in the Guillotine Room of the Physical Laboratory at the University of Edinburgh The ordinary mathematical theory of elasticity, based on a linear connexion between the stress tensor and the strain tensor, is competent to give an opinion on phenomena conforming to its range of limitations, but it makes no pretensions of prognosticating any resulting permanent set, though it might adumbrate the nature of secondary phenomena In the experiments carried out by Andrews on metal spheres, it appears that the permanent set takes a shape suggestive of a lunar crater There is a distinct depression, with a rather uneven and somewhat curved floor, surrounded by a raised rim The phenomena had been previously observed by Sir C V Raman and other investigators The results derived from experiments with low velocity of impact substantiate Hertz's theory that the time of impact is inversely proportional to the fifth root of the velocity An empirical law is given for the duration of impact in other cases, and a hypothesis is framed to explain the various results The essential feature of the hypothesis is that the pressure is constant at all points of the deformed area; it affords an explanation in a region where the exact mathematical theory is inadequate.

Atomic Weights of Nitrogen and Silver—The atomic weight of nitrogen by the gravimetric method is intimately related to that of silver through the ratio Ag $AgNO_3$ More recent measurements of the limiting density of ammonia have given accurate values with respect to hydrogen, and other lines of evidence show that the value (referred to O as 16) is very nearly 14 008 (the oxygen standard is the isotopic mixture) Baxter and Greene in the February *Journal of the American Chemical Society* describe the determination of the ratio Ag NH_3, which with the ratio Ag NO_3 gives the ratio NH_3 NO_3 This, with the assumption of the H O ratio, makes possible the calculation of the atomic weight of nitrogen The principle of the method had been applied by Stas A weighed quantity of ammonia adsorbed on dehydrated chabazite was evaporated into dilute hydrochloric or hydrobromic acid until the acid was exactly neutralised The halogen content of the solution was then found by nephelometric comparison with the purest silver in the usual way Great precision in the neutralisation end point could be attained by using methyl red or litmus as indicator The ratio $NO_3/Ag = 0\ 57479$ was assumed The ratios Ag $NH_3 = 6\ 33401$ and NO_3 $NH_3 = 3\ 64073$ give $N = 14\ 0085$ (isotopic mixture of oxygen = 16) These numbers are not corrected for a very small amount of water in the ammonia, and on the whole the final outcome is regarded as valuable corroborative evidence that the atomic weight of nitrogen is very close to 14 008 If nitrogen is taken as 14 0078, the atomic weight of silver will be 107 879, whilst $N = 14\ 008$ gives $Ag = 107\ 880$ from the Ag NH_3 ratio and 107 879 from the Ag NO_3 ratio

Oxygen Films on Tungsten Langmuir and Villars in the February *Journal of the American Chemical Society* describe a method of studying the rate of loss of oxygen from an adsorbed film on tungsten, as well as of detecting its presence in a gas which consists in observing the effect on the electron emission of a tungsten filament, sensitised by the presence of a minute trace of cæsium vapour (10^{-6} mm) Under properly chosen conditions a monatomic oxygen film makes its presence known by increasing the emission a million fold By this method the heat of evaporation of oxygen from the adsorbed layer was calculated as 162 k cal per gram atom The method of preparing the filament and the experimental procedure are described in the paper and it is suggested that the method which is not in general use, may be capable of much wider application in chemical investigation The results also show that adsorbed oxygen films on tungsten surfaces are held by enormous binding forces, very much greater than those corresponding to the heat of dissociation of the oxygen molecule The method makes use of the fact previously discovered by Langmuir and Kingdon that a minute trace of cæsium vapour may produce an electron emission from heated tungsten up to 640° abs many billion fold greater than that from pure tungsten At higher temperatures this emission passes through a maximum at 715° abs and decreases with further rise in temperature This drop in emission is due to the evaporation of the cæsium from the surface The oxygen increases the stability of the cæsium film, holding it much more firmly than tungsten does, and the effect of the presence of an oxygen film is to hold cæsium atoms which would otherwise evaporate under the same conditions of temperature and pressure

Grassland Research in the British Empire.

THROUGHOUT the British Empire there are vast tracts of natural pastures which produce herbage of an inferior nutritive value A large body of evidence has been accumulated in recent years to show that this low nutritive value is to be correlated with deficiencies of inorganic constituents, such as calcium, phosphorus, and chlorine, in the herbage, a condition which is the outcome of growth on mineral deficient soils Animals ranging over these pastoral areas and subsisting exclusively on such mineral deficient herbage, display a low rate of growth and production compared with what is possible on good cultivated pastures With this decreased growth rate are usually associated lowered fertility and susceptibility to various forms of disease

During 1926, the committee appointed by the Economic Advisory Council to consider the question of the mineral content of natural pastures recommended that practical investigations should be carried out in a suitable colony or dependency with the view of ascertaining whether the nature of such deficiencies could be determined and the diseases due to them prevented Following this recommendation, a scheme of research was inaugurated which serves as a model of successful co operative effort Kenya Colony was selected as the site of the investigations, and Dr J B Orr, director of the Rowett Research Institute, Aberdeen, assumed the general scientific direction The Empire Marketing Board rendered signal help by placing generous funds at his disposal Close and enthusiastic co operation was established between his own staff of research assistants, some of whom worked in Aberdeen and others in Kenya, and the staff of the Agricultural Department in Kenya Colony In addition valuable assistance was given by settlers in the colony, many of whom provided animals and facilities for feeding experiments

The initial outcome of these important investigations is revealed in the Report now before us which has been drawn up by Dr Orr in association with Mr A Holm, director of agriculture, Kenya * Though the main scheme of work is still in its early stages, the results so far obtained are of the highest economic significance and amply justify the trouble which has been taken to secure them

It has been shown that the most striking deficiency in the natural pastures of Kenya is that of phosphorus Indeed, in one district, Molo, the deficiency of this element is as great as that found in certain areas of South Africa, where it is the cause of disease in cattle On the other hand, in another district, Naivasha, the pasturage, apart from deficiency in sodium and chlorine, is as rich as the herbage of good British cultivated pastures The application of different fertilisers in the most deficient area increased the yield of herbage from 25 per cent, where common salt only was used, to as much as 400 per cent where nitrogenous and phosphatic fertilisers were employed The provision of small amounts of the deficient minerals to animals grazing these areas was followed by an increase of 30 per cent in the yield of dairy cows, 10 per cent in the rate of growth of lambs, and about 10 per cent in the weight of the fleeces of sheep

It was discovered that 'Nakuruitis', a local disease resembling the 'bush sickness' of New Zealand, could be prevented by allowing animals access to a mixture of common salt and iron oxide This method of prevention is now being applied with successful results on several farms in Kenya, oxen being kept in good condition for at least a year, whereas formerly, without the use of this simple salt lick, it was impossible to keep them free from the disease for longer than six months without sending them away for a period of grazing in another district

H E Woodman

* Economic Advisory Council Committee on the Mineral Content of Natural Pastures Sixth Report Pp 66 (London H M Stationery Office 1931) 1s net

Medicinal Cod Liver Oil *

ALTHOUGH the medicinal value of cod liver oil has been known for 150 years, it is only recently that it has been attributed to the presence of vitamins A and D It is now known, moreover, that different samples of oil vary widely in their vitamin potency as well as in their more obvious chemical and physical characteristics The principles underlying the production of a fine medicinal oil of high activity should be established so that consumers can always be certain of obtaining full benefit from its administration The recently issued Empire Marketing Board Report by Profs J C Drummond and T P Hilditch provides specifications for cod liver oil which are based on the examination of a large number of samples over several years, and makes recommendations for suitable methods of manufacture

The investigators examined oils from Newfoundland Scotland and the North Sea, Iceland, and Norway, obtained at different seasons, for vitamin potency, colour and fatty acid content, and estimated their saponification and iodine values oils from other fish were also compared with cod liver oil Vitamin A was estimated both by the growth test on rats and by the antimony trichloride colour test in a series of oils very fair agreement between the two methods was obtained, so that the quicker and simpler colour test was used during the greater part of the research as an estimate of the vitamin A potency Using standard conditions, the results can be expressed in Lovibond blue units, it was not found possible to express the results of assays by the biological method in units, owing to the errors of the animal test Vitamin D was estimated by the degree of deposition of calcium at the ends of the long bones of rachitic rats as observed under X rays and following staining with silver nitrate (the 'line test') the assays were carried out against the standard preparation of irradiated ergosterol employed by the Pharmaceutical Society and the results expressed in terms of the Coward antirachitic unit

The Newfoundland and Icelandic oils had the highest vitamin potency, the Norwegian the lowest, with the Scottish intermediate, but usually of the same order of activity as the latter The vitamin A and vitamin D potencies were usually parallel

A detailed chemical examination of the constituent fatty acids of cod liver and other oils was made the methods and results have been published in full in the *Biochemical Journal*, by Guha, Hilditch, and Lovern (vol 24, p 266, 1930) and by Lovern (*ibid*, p 866) The general composition of the fatty acids of cod liver oil is stearic and myristoleic acids, traces only, myristic acid, 3-7 per cent, palmitic acid,

* The Relative Values of Cod Liver Oils from Various Sources By Prof J C Drummond and Prof T P Hilditch (E M B 35) Pp 129 (London H M Stationery Office 1930) 1s net

7·13 per cent, palmitoleic acid, 13·20 per cent, oleic and linoleic acids, 18·33 per cent, unsaturated acids containing 20 carbon atoms, 19 32 per cent; unsaturated acids containing 22 carbon atoms, 10·19 per cent The depth of the yellow colour of the oil was found to be roughly proportional to its vitamin potency

The variations in potency of different samples are not apparently directly dependent on the age or sexual condition of the fish, but on the character and amount of the food eaten, which varies according to the season On the other hand, examination of the fish and several crustacea which form the food supply of the cod showed them to be singularly devoid of both vitamins It has been shown that phytoplankton synthesise vitamin A (Ahmad, *Biochem Jour*, vol 24, p 860, 1930) zooplankton contain none and neither contain appreciable quantities of vitamin D, although there may be small amounts present in zooplankton There is no evidence that the cod can synthesise either, though the possibility cannot be excluded The alternative is that the fish retains the small amounts in its food in its liver, so that over a course of months with a plentiful food supply this organ comes to contain considerable amounts The potency of the oil varies inversely with the amount obtained from the liver prior to spawning there is a utilisation of the liver fat, especially in the female, but the vitamin store is not proportionally depleted, so that the oil has a high potency The authors believe this to be the explanation of the high vitamin content of Newfoundland oil

From an examination of the effects of different methods of manufacture upon the palatability, keeping properties, and potency of the oil, the following procedure is recommended Livers should be fresh and steamed immediately they have been removed from the fish Steam at 60 100 lb pressure per sq in gives better results than steam at a lower pressure, and the process should not be too short Subsequent refining should be restricted to removal of moisture, debris, and stearine by chilling and centrifuging or pressure, finally, medicinal oils should be stored in vessels impermeable to light and containing as little free air space as possible Deterioration is caused by the activity of the liver enzymes, hence the necessity for using only fresh material and for adequate steaming to destroy them High pressure steam also gives a higher yield of oil It was found that the replacement of air in the storage casks by an inert gas was difficult to carry out properly and did not increase the keeping properties of the oil Protection from light and undue exposure to air is, however, of great importance

As a result of their work, the authors put forward the following specifications for medicinal cod liver oil The colour, when measured in a 1 in cell, should not be greater than 10 yellow Lovibond units and 0 5 red unit The free fatty acid (as oleic acid) should not be greater than 0 5 per cent, preferably below 0 3 per cent The unsaponifiable matter should not be more than 1 5 per cent, preferably below 1 per cent The vitamin A colour test should give a higher value than 7 blue Lovibond units, when carried out by the authors' technique For oil intended for farm stock, the colour and free acidity may be slightly greater but the amount of unsaponifiable matter and vitamin A present should be the same There appears to be no doubt that oils from Scotland and, especially, Newfoundland are capable of meeting those specifications

Mosquito Control *

THE Report for 1930 of the British Mosquito Control Institute, Hayling Island, Hampshire, is a record of two and a half years' work, the previous Report having been presented in June 1928 The Institute, it may be added, was built and equipped in 1925 by Mr John F Marshall, who has since occupied the position as director without remuneration It was incorporated by licence of the Board of Trade in February 1927 and, by a deed executed at the same time, the building and its equipment were leased to trustees for a term of years No financial aid is received from any official funds, and the income of the Institute is derived solely from the results of its own activities and from subscriptions and donations Funds are greatly needed in order to enable the work to become more self supporting, since the present income falls a long way short of covering expenditure

The activities of the Institute have markedly increased since the issue of the last Report, and the interest shown by the outside public in this work is borne out by the fact that more than 1400 visitors (scientific and others) inspected the museum and laboratory during 1930 Advisory work relating to mosquitoes, their identification and control, is carried out by means of inspection and by correspondence Inspections are generally undertaken by the director's assistant at a pre-arranged charge which includes the submission of a report and the recommendation of remedial measures Various lines of investigation have been carried out during the period under review, including tests of fly killing preparations and of cresol-containing larvicides, at the request of commercial firms A study has also been commenced with regard to the breeding of arboreal mosquitoes in cavities (natural and artificial) in sawn off parts of trees of different species

In June 1929 a special malaria course, arranged in connexion with the League of Nations and the London School of Tropical Medicine, included in its programme a three day visit to the Institute for laboratory and field instruction A number of medical officers took part in this work. In September 1930 a week's course, of a tentative character, on mosquito research for university students was given, and was sufficiently appreciated to warrant arrangements being made for its repetition during the present year Among other educational activities, the director has delivered lectures on mosquito control to various institutions, etc, while demonstrations have been conducted at a number of scientific meetings, exhibitions, etc By way of technical apparatus, the advances made in connexion with photomicrography and stereograph methods are described in the Report Mention needs also to be made of the small but growing library of the Institute a number of new books have been added both by gift and by purchase, while certain of the more important periodicals are taken in regularly The director of the Institute is to be congratulated upon the initiative and energy he is giving to the development of his charge and on the progress so far achieved

Scientific societies, educational bodies, local authorities, and other associations desirous of supporting this useful work may become 'collective' members Members (whether individual or collective) subscribe one guinea per annum and receive a copy of the publications of the Institute

* British Mosquito Control Institute Report of the Director Presented at the Fourth Annual General Meeting, Dec 9, 1930 16 pp and 30 illustrations Hayling Island, Hampshire

Grey and Red Squirrels in Britain

FOR years, naturalists have been familiar in a general way with the aptitude shown by the American grey squirrel for colonising parts of Britain, with the controversy regarding the harmfulness or otherwise of its habits, and the allegation that it has driven the native red squirrel before it. Never before, however, has an attempt at all comparable with that of Mr. A. D. Middleton * been made to collect all the facts regarding this undesirable alien before passing judgment upon it. The paper also contains information relating to the fluctuations and decline of the red squirrel in Great Britain, so important that this species, too, might well have shared a place in the title.

So long ago as 1830, the grey squirrel was known in Montgomeryshire and Denbighshire, but the present state of affairs is almost wholly due to introductions since 1890. Thirty-three different introductions, involving twenty-nine localities, have been traced, and the sum of their results is astonishing. By 1930 the grey squirrel, according to Mr. Middleton's thorough census, had populated a total area of approximately 13,350 square miles, mainly in southern England, Cheshire, and Yorkshire, and there is every reason to believe that it will eventually cover the whole country, with the possible exception of mountainous districts such as northern Scotland.

Although much of the evidence regarding the food of the creature is unbalanced or biased, there can be little doubt that it is a nuisance in Great Britain. Green food, fruit, and nuts form the major part of the food supply; but it robs birds' nests of their eggs and young, and the damage it does to woodland by biting off young shoots and leaders, and by peeling or ringing the bark of young trees (the present writer has seen branches of old trees girdled as well), is enough to condemn it in the eyes of every forester. The fact that at least 750,000 acres of new forest are in progress of being planted suggests that here lies a potential food store to encourage fresh colonisation, and points to a new danger in the presence of the grey squirrel.

It has often been said that the grey squirrel kills out or drives away the native red squirrel, but no direct evidence of such antagonism has been forthcoming. The present writer agrees entirely with Mr. Middleton's view that in many areas (in Scotland, at any rate) the red squirrel has declined, apart altogether from the presence of its possible rival. Nevertheless the red squirrel almost holds its own in some of the extensive northern forests, and it must surprise many readers to learn that the Highland Squirrel Club, in a limited area confined to thirty-six estates in the north of Scotland, destroyed in the years from 1903 to 1929, 82,000 squirrels.

In considering the future possibilities of the introduced grey squirrel as a serious economic pest, it is well to remember that, so far as Scotland is concerned, the red squirrel itself is a species that was reintroduced after it had almost or wholly disappeared, about the beginning of the nineteenth century. One would imagine that the tale of the risk of introductions was written plain enough for anyone to see, and yet the process goes merrily on: within the last few years the musk rat has been added to the Scottish list of aliens likely to call down future curses upon the heads of its thoughtless or ignorant sponsors.

J. R.

* A. D. Middleton: The Ecology of the American Grey Squirrel (*Sciurus carolinensis*) in the British Isles , *Proc. Zool. Soc. London*, part 3, p. 809, 1930.

Birthdays and Research Centres.

April 2, 1853.—Prof. P. PHILLIPS BEDSON, emeritus professor of chemistry, Armstrong College, Newcastle-on-Tyne.

In describing some experiments on the gases enclosed in certain varieties of coal dust, at a meeting of the North of England Institute of Mining and Mechanical Engineers in 1888, I directed attention to the fact that the inflammable constituent appeared to contain other members of the paraffin series in addition to methane (marsh gas). In the discussion, the late Sir Charles Parsons suggested that the examination of the gases released from the coal yielding such dust, by grinding it in a vacuum, might afford information on the composition of these gases. In the session 1913-14, I had contrived a method of testing this suggestion, but was unable to complete the investigation, as on the outbreak of War the buildings of Armstrong College were taken over by the military authorities, and when possession was regained in 1919 opportunity for pursuing the investigations further did not present itself. In 1921, I resigned from the professorship of chemistry in Armstrong College and came to reside in the south of England. The repetition of this work in the light of the influence of these gases on the ignitability of mixtures of air and coal dust, and the examination of firedamp for the presence of other paraffin hydrocarbons than methane, is a problem to which attention might usefully be given.

April 5, 1865.—Sir JOHN BRETLAND FARMER, F.R.S., emeritus professor of botany and formerly director of biological laboratories, Imperial College of Science and Technology, London.

Amongst the various lines of research in which I happen to have been specially interested, there are few, I think, which offer more attractive possibilities than those which concern excretion, in the larger sense of the term. The mechanism by which sugar in a concentrated state is excreted in nectaries (and by various other non-floral glands), though doubtless not too easy to investigate, is one which can surely yield a much larger harvest on the way towards its solution than it has yet produced. Of course, it may be said that the whole matter is a question of energy—and this observation was actually made to me by a very eminent physiologist of his day, some twenty years ago. But it is clear that very little is thereby really gained. No doubt the energy for moving a train is derived from the combustion of coal in the engine, but that tells nothing of the *machinery* and of the steps whereby the energy derived from oxidation of coal is enabled to be utilised for moving the train.

A set of problems akin—perhaps more than is at first sight obvious—to those just referred to, concern the internal movement of water within the higher plant, wherever protoplasm takes a hand in the matter. Much has from time to time been written about 'root pressure', but how much is really *known* as to the *Wesen* of root pressure? It is a subject I have myself pursued, not too successfully, for a number of years, though I did find a few side tracks which seemed to be more hopeful than the main route. It would be useful to know to what extent and under what precise conditions the sugars derived from the surrounding living parenchymatous cells find their way into the dead wood vessels. Semi-permeability has really ceased to be a rigorous dogma where living protoplasm is concerned. It is another example of the truth that 'circumstances alter

cases' By that same track we get into closer touch with the problems of spring bleeding so characteristic of many trees, etc, though in different degrees, and varying under different external conditions

In concluding the few remarks, which have filled more than the space allotted to me, may I venture to suggest that many of our younger botanists, particularly those who are physiologically minded, might profitably acquire a larger horticultural knowledge of growing plants than most of them seem to possess? The problems of the garden are numerous and profitable, but a practical fore knowledge of the garden and its denizens is essential for their recognition, the garden is a more fertile source of inspiration and research than many shelves of 'pickle' bottles

April 5, 1868—R H Burne, F R S, physiological curator at the Royal College of Surgeons, London

During the past few years I have been much interested in certain peculiarities of the lymphatic system of Teleostean fishes, which suggest that in the early stages of its differentiation the lymphatic system comprised both afferent and efferent factors comparable to arteries and veins I am now carrying on similar researches into the constitution of the pseudo lymph system in the skin of Elasmobranchs, in the hope of determining the nature of the 'cutaneous veins' and their morphological relationship to the rest of the vascular system and to the cutaneous lymphatics of other fishes

April 11, 1890—Prof E K Rideal, F R S, professor of colloid physics in the University of Cambridge

We are engaged in determining the potential difference existing at air liquid interfaces and also at gas metal interfaces This potential difference is modified to a marked extent by the presence of a unimolecular film, for example, a fatty acid film on a water surface or alcohol on a gold surface These changes caused by films of different types, of different surface concentrations, of films undergoing chemical reaction or simple solution or evaporation, can be measured with considerable accuracy

Societies and Academies

London

Institute of Metals (Annual General Meeting) Mar 12—**C E Pearson** and **J A Smythe** The influence of pressure and temperature on the extrusion of metals The paper describes experiments made in a small press on the extrusion phenomena of the metals lead, cadmium, bismuth, and tin The chief part of the work is concerned with the determination, under precise control, of the relationship between the rate of extrusion, pressure, and temperature This relationship is expressed in a series of curves, the mathematical treatment of which is indicated—**J D Grogan** and **D Clayton** Dimensional stability of heat-treated aluminium alloys Careful search has failed to reveal the occurrence of secular change in certain commercial heat-treated aluminium alloys, subsequent to the completion of the normal ageing process Serious dimensional changes occur when machining operations are carried out on material quenched in cold water—**D Hanson** and **M A Wheeler** The deformation of metals under prolonged loading (1) The flow and fracture of aluminium The principal method used consisted in examining the changes in microstructure of polished specimens, subjected to static stresses at room and elevated temperatures The extension under a prolonged load that will ultimately break the metal may be considered as consisting of a period of primary extension, during which the rate of flow diminishes, a period during which flow is very slow or even suspended, and a period during which the extension again increases continuously until fracture occurs Failure under creep conditions may be due to intercrystalline cracking, resumption of slipping within the original crystals, or recrystallisation Failure of aluminium under various conditions was examined Rupture of the crystals probably commences along slip planes formed at an early stage in the deformation of the metal—**K L Meissner** The effect of artificial ageing upon the resistance of super duralumin to corrosion by sea water A different 'pock form corrosion', combined with highly deleterious effect on the tensile properties, and primarily caused by intercrystalline corrosion, was found in an intermediate range of annealing temperature at 125° 145° C, and especially at 140° C—**S L Archbutt** and **W E Prytherch** Investigation of the effects of impurities on copper (7) The effect of antimony on copper—(8) The combined effect of antimony and arsenic on copper In the antimony copper series, alloys containing up to 0 85 per cent antimony have been studied, and in the arsenic-antimony copper series, up to 0 5 per cent of each impurity together In the former series, alloys containing up to 0 47 per cent antimony withstood hot rolling and up to 0 85 per cent cold rolling from cast billets An alloy containing 0 85 per cent antimony was hot short In the latter series all compositions withstood rolling either hot or cold Antimony is highly soluble in solid copper, and small additions of this element to copper low in oxygen are found to improve the tensile strength at ordinary temperatures and at 250° C the fatigue properties, and to raise the softening temperature (of cold worked material), without impairing ductility or toughness Copper low in oxygen, containing antimony and arsenic together, appears to withstand hot rolling better than with antimony alone The mechanical properties of copper low in oxygen are improved by small additions of antimony and arsenic together Both impurities lower the electrical conductivity of copper **L J Brice** Some properties of silicon-'aluminium bronzes' The paper describes the results of a detailed study of the Brinell hardness, mechanical properties, and microstructure of three typical aluminium copper alloys, containing respectively 5 0, 7 25, and 10 0 per cent aluminium, with the addition to each of up to 5 0 per cent silicon—**Owen W Ellis** The rolling of alloys of copper and phosphorus containing up to 5 per cent of phosphorus The plain phosphorus copper alloys can all be successfully hot rolled at 450° 650° C to produce strip 0 021 in thick, provided that only small reductions of thickness are made at each stage of the rolling In this way the copper copper phosphide eutectic structure is thoroughly broken up, and the strip can then be cold rolled to 0 015 in

Paris

Academy of Sciences, Feb 16—**Jean Rey** The conditions for the best utilisation of the energy of warm water, natural and industrial—**Georges Claude** Remarks on the preceding communication—**E Mathias** The destructive effects of lightning upon plants A discussion of the cause of the observed fact that when a single tree is struck by lightning and killed, and the lesions on the tree are obvious, plants and trees within a certain radius of this tree also die, although there are no lesions to account for this—**Edmond Sergent, A Donatien, L Parrot**, and **F Lestoquard** Etiological considerations on north

African bovine theilerosis Nine tenths of the cases occur between June 15 and Aug 31 in each year This is explained by a study of the life histories of the micro organism *Theileria dispar* and the transmitting tic, *Hyalomma mauritanicum* —Paul Pelseneer was elected *correspondant* for the Section of Anatomy and Zoology, in succession to the late A Brachet —**Potonniée** The discovery in Russia of unpublished letters of Nicéphore Niepce, the inventor of photography —**J Doubnoff** The fundamental tensors of a rectilinear congruence —**Mlle Marie Charpentier** The Peano points of the equations $y' = f$ for which the unicity of the solution is assured of one side —**Georges Bouligand** The commencing movement of a liquid mass —**Benjamin Jekhowsky** Exact and simple formula for the identification of the minor planets —**J Dourgnon** and **P Waguet** The photometric properties of rough diffusing surfaces —**R Zouckermann** High frequency discharges in nitrogen in the presence of mercury —**G A Boutry** The characteristic surface $i = f(F\ V)$ of a photoelectric cell with a gaseous atmosphere —**E L Harrington** The nature of the radioactive groupings of atoms Although it is probable that groupings round impurities as nuclei may take place, it is doubtful whether the presence of impurities is the essential factor The nucleus may be a particle of an impurity, but is generally a stable association of ionised radio active atoms —**Mme Mathieu, Mathieu, and Paic** Some reactions produced in the solid state A list of chemical reactions between two solid substances is given It is suggested that reactions produced by grinding in a mortar would be those in which the molecular volume of the system would be reduced by a reaction, but this does not appear to be the case, with the examples given —**H Muraour** and **G Aunis** The laws of combustion of colloidal powders (explosives) containing vaseline —**E Rinck** An allotropic transformation of calcium in the solid state Experiments are described, proving the existence of two allotropic varieties of the metal calcium, the transformation point being 450° C —**E Carrière** and **Raulet** Contribution to the study of the sodium silver hyposulphite complexes —**L Hackspill** and **J Weiss** The hypophosphites of cæsium and of rubidium The properties of cæsium and rubidium hypophosphites resemble those of the other alkaline hypophosphites Their density increases in the same sense as their atomic weight, and the decomposition on heating is similar to that of the other alkaline salts —**Mme Ramart-Lucas** and **Mme Bruzau** Absorption and reactivity of the ketone function Arguments against the theory of steric hindrance, with special reference to the case of the hexalkyl acetones It appears possible to explain the variations in the chemical activity of the ketonic group by a mutual influence between the alkyl radicals present in the molecule without steric hindrance intervening —**A Mailhe** and **Renaudie** The transformation of the butylenes into liquid hydrocarbons Study of the catalytic action of silica at 650° 700° C on the butylenes —**Léon Moret** Discovery of the Purbeckian in the Semnoz Chain, near Annecy (Haute Savoie) —**V Perebaskine** Observations on the geology of the Gabon —**Roger Heim** The spore in the genus *Inocybe* —**St Jonesco** The formation of anthocyanic pigments in the etiolated shoots of buck wheat and of wheat —**E Michel-Durand** The influence of light on the migration of nutritive material at the moment of bursting of buds —**A Brunel** The presence of allantoinase in many fungi The ferment is recognised by its converting allantoin into allantoic acid a list of 66 fungi containing allantoinase is given —**Mme L Randoin** and **R Lecoq** Constitution of a new food regime for the study of B avitaminoses, containing reduced proportions of glucides but rich in lipides —**A** and **R Sartory** and **J Meyer** Phenomena resulting from the irradiation of the cutaneous tissue and of the male genital gland of the rabbit as a function of the mode of application of the radiation

Raymond-Hamet The pharmacological influence of the substitution of a methyl group on the β carbon of the methylamino paraoxyphenyl carbinol —**Jean Saidman, Roger Cahen, and Jacques Forestier** The action of electric fields of very high frequency on organic tissues Description of the technique found best for human subjects —**J Verge** and **M Vallée** *The treatment of diarrhœa of calves by the bacteriophage* The specific bacteriophage has been isolated from the intestine of convalescent subjects and subjected to further laboratory treatment Accounts of various cases in which the treatment was beneficial are given

ROME

Royal National Academy of the Lincei Communications received during the vacation, 1930 —**U Cisotti** Hemisotropic quintuple tensors —**M La Rosa** and **G Petrucci** A circuit emitting trains of discontinuous waves —**G Mammana** A fundamental theorem of mathematical analysis Treatises on the calculus deal with a theorem of reduction of a multiple series or one of inversion, a theorem of integration and derivation by series a theorem of reduction of total derivative, one of inversion of the order of derivation, etc, as so many detached propositions All these theorems and, in general, all those leading to reduction or inversion of limits are immediate corollaries of a single theorem, and an attempt is now made to establish this with the maximum possible generality —**Maria Nasta** Contribution to the calculation of the critical velocity of motor shafts —**Bice Pelini** Table of the potential of a magnetic lamina with a circular rim A description is given of the method of compiling a table to show, for various points in space and with an error less than 1 in 1000, the potential of a magnetic lamina with a circular rim and with unit intensity of magnetisation —**G Krall** Problems of the dynamics of the binary —**E Segrè** The Raman effect of acetylene An apparatus for the study of the Raman effect in gases in the visible spectrum is described, and the results obtained with acetylene are given —**D Graffi** Considerations on the theory of the transmission of heat by forced convection —**A Baroni** Methylselenomercaptan This compound, CH_3SeH, obtained by treating an alcoholic solution of sodium hydroselenide with methyl iodide, is an almost colourless liquid of persistent, unpleasant odour and boils at 12° C The mercury, lead, silver, copper, and bismuth derivatives are described —**Giovanni Sani** Investigations on oleastene, a hydrocarbon contained in the fruit of the olive The formula of this hydrocarbon is at least C_7H_{12} and is probably $C_{21}H_{36}$ —**G Mezzadroli** and **E Vareton** Action of ultra short magnetic waves (λ2 3 metres) on silk worms The best procedure to be followed, in applying these waves to silk-worms, is described The weight of the cocoons formed by the irradiated worms is greater by 19 per cent than that of the cocoons from the controls —**M Mitolo** The moderating power of the central nervous tissue This tissue is endowed with a moderating power which is of a physico chemical character and is probably due to certain acid-salt systems (phosphoric acid phosphates, carbonic acid carbonates, etc) with an equilibrium near the neutral point and with low dissociation constants, rather than to proteinates —**L. Bracaloni** Normal hydræmic curve (on fasting) during various physical exertions of short duration —**Clara Forti**: Excision of the vessels and nerves of the ovary: Historical notices (1)

Official Publications Received.

BRITISH

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1929–1930. (Cmd. 3786.) Pp. 138. (London: H.M. Stationery Office.) 2s. 6d. net.

Researches published from the Wards and Laboratories of the London Hospital during 1930. 38 papers. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 15, 1930. Pp. 758. (London.) 7s. 6d. to Members; 12s. 6d. to others.

Dominion Bureau of Statistics: Canada. 1931: an Official Handbook of Present Conditions and Recent Progress. Pp. vii + 199. (Ottawa: Dominion Bureau of Statistics; London: High Commissioner for Canada.) 25 cents.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1931, Vol. 43, No. 1, February. Pp. 56+xliv. (London.)

The National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended December 31st, 1930. Pp. 36. (London.)

The Proceedings of the Physical Society. Vol. 43, Part 2, No. 237, March 1. Pp. viii+119-226. (London.) 7s. net.

Proceedings of the Royal Society. Series A, Vol. 130, No. A815, March 3. Pp. 551-697+xxxiv. (London: Harrison and Sons, Ltd.) 8s.

Mysore Geological Department. Records, Vol. 26, 1927. Pp. iii+28. (Bangalore: Government Press.) 2 rupees.

Education, Simla. Education in India in 1928–29. Pp. iv+74. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1s. 6d.

The Journal of the Royal Technical College. Vol. 2, Part 3, January. Pp. iv+371-566. (Glasgow: Robert Anderson and Sons, Ltd.) 10s. 6d.

Allahabad University Studies. Vol. 5. Pp. v+495. 7.8 rupees. Vol. 6, Part 1 (Arts, Law and Commerce). Pp. iv+888. 7.8 rupees. Vol. 6, Part 2 (Science Section). Pp. v+257. 7.8 rupees. (Allahabad.)

British Mosquito Control Institute. Report of the Director, presented at the Fourth Annual General Meeting held in the Rooms of the Entomological Society of London on the 9th December 1930. Pp. 16+15 plates. (Hayling Island.)

The Quarterly Journal of the Geological Society of London. No. 345, Vol. 87, Part 1, February 28th. Pp. 179. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

The Association of Women Science Teachers. Report for 1930, and List of Members. Pp. 52. (London.)

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 16, No. 97, March. Pp. 151-216. (London: Williams and Norgate, Ltd.) 5s. net.

Tanganyika Territory: Geological Survey Department. Annual Report, 1929. By Dr. E. O. Teale. Pp. iii+60+6 plates. (Dar es Salaam: Government Printer.) 4s.

University of Leeds. Twenty-sixth Report, 1929–30. Pp. 174. Publications and Abstracts of Theses by Members of the University during Session 1929–30. Pp. 54. (Leeds.)

Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 1: Irish Sea Trout: Notes on Collections of Scales from the West Coast of Ireland. By G. Herbert Nall. Pp. 36+3 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 39: Some Geochemical Applications of Measurements of Hydrogen Ion Concentration. By Dr. W. R. G. Atkins. Pp. 455-460. 6d. Vol. 19 (N.S.), No. 45: Photo-electric Measurements of Illumination in relation to Plant Distribution. Part 3: Certain Spruce, Larch, Oak and Holm Oak Woods. By Dr. W. R. G. Atkins and Florence A. Stanbury. Pp. 517-531. 1s. Vol. 19 (N.S.), No. 46: The Distribution of Pasture Plants in relation to Soil Acidity and other Facts. By Dr. W. R. G. Atkins and E. Wyllie Fenton. Pp. 533-547. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Armstrong College, Newcastle upon Tyne. Standing Committee for Research. Report, Session 1929–1930. Pp. 31. (Newcastle upon Tyne.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda, No. 1342 (Ae. 474—T. 2965): Airscrews for High Speed Aeroplanes. By H. Glauert. Pp. 18+6 plates. 1s. net. No. 1348 (Ae. 480—T. 2994): On the Validity of Large Scale Tests in an Open Jet Wind Tunnel—Tests on one-fifth Scale Bristol Fighter (7.9 ft. Span) in 5 ft. Open Jet Tunnel. By W. G. A. Perring and C. Callen. 9d. net. (London: H.M. Stationery Office.)

The Polar Record. No. 1, January. Pp. 35. (Cambridge: At the University Press.) 1s.

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 14, No. 56, December 1930. Pp. xii+131-212+307-424+315-511+xxvii. (Sheffield.) 10s. 6d.

The Ninety-seventh Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 6, Part 4, 1930. Pp. xliii-iii+313-425+viii+14. (Camborne.) 5s.

Sydney University Reprints. Series 8 (Chemistry, Organic and Inorganic). Vol. 1, Nos. 45-61. 17 papers. Series 9 (Medical Sciences Non-clinical). Vol. 2, Nos. 18-38. 26 papers. (Sydney, N.S.W.)

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 17: New Fossils from the Productus Limestones of the Salt Range, with Notes on other Species. By Dr. F. R. C. Reed. Pp. v+56+8 plates. (Calcutta: Government of India Central Publication Branch.) 5.6 rupees; 8s. 9d.

Liverpool Observatory and Tidal Institute. Annual Report 1930. Pp. 18. (Liverpool.)

The Half-Yearly Journal of the Mysore University. Vol. 4, No. 2, July, 1930. Pp. 145-261. (Bangalore.) 2 rupees.

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 6, Part 3, February. Pp. 337-506+plates 28-38. (London: Adlard and Son, Ltd.) 19s. net.

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 4, March. Pp. 155-218+plates 18-25. (London: Dulau and Co., Ltd.) 10s. net.

Report of the British Museum Expedition to British Honduras, 1930. By Capt. E. L. Gruning. (Reprinted from the Journal of the Royal Anthropological Institute, Vol. 60, July–December 1930.) Pp. 477-483+plates 16-22. (London: Royal Anthropological Institute.) 1s.

Proceedings of the Prehistoric Society of East Anglia for 1930. Vol. 6, Part 3. Edited by G. Maynard. Pp. xii+147-251+plates 12-19. (London: H. K. Lewis and Co., Ltd.; Geo. Salby.) 20s. net.

Proceedings of the Society for Psychical Research. Part 120, Vol. 40, February: Library Catalogue (Supplement 1929–1930). Pp. 55. (London.) 1s. 6d.

The Journal of the Board of Greenkeeping Research. Vol. 2, No. 4, March. Pp. 88+xxxi+8 plates. (Bingley: St. Ives Research Station.) 2s. 6d.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 411, March. Pp. 325-444+xxvi. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The British Mycological Society Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 15, Parts 3 and 4, March 21. Pp. 193-378. (London: Cambridge University Press.) 15s.

Papers from the Geological Department, Glasgow University. Vol. 13 (Octavo Papers of 1926–1930). (Glasgow University Publications 20.) Pp. viii+20 papers. (Glasgow: Jackson, Wylie and Co.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 60, July to December 1930. Pp. ix+269-558+plates 4-22. (London.) 15s. net.

Medical Research Council. Tenth Annual Report of the Industrial Health Research Board (formerly the Industrial Fatigue Research Board) to 31st December 1929. Pp. 29. (London: H.M. Stationery Office.) 6d. net.

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 28: The Stem Endodermis in the Genus Piper. By Dr. George Bond. Pp. 695-724+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5s.

FOREIGN

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 19, No. 5. Pp. 473-680. Fourth Series (Biology), Vol. 5, No. 4. Pp. 615-837. (Tokyo and Sendai: Maruzen Co., Ltd.)

Columbia University Bulletin of Information. 31st Series, No. 17: Announcement of Professional Courses in Optometry for the Winter and Spring Sessions 1931–1932. Pp. 31. (New York City.)

United States Department of the Interior: Geological Survey. Bulletin 821-B: A Geologic Study of the Madden Dam Project, Alhajuela, Canal Zone. By Frank Reeves and Clyde P. Ross. (Contributions to Economic Geology, 1930.) Pp. iv+11-49+plates 4-13. 40 cents. Water-Supply Paper 622: Surface Water Supply of the United States, 1926. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+118. 20 cents. Water-Supply Paper 644: Surface Water Supply of the United States, 1927. Part 4: St. Lawrence River Basin. Pp. v+159. 25 cents. Water-Supply Paper 649: Surface Water Supply of the United States, 1927. Part 9: Colorado River Basin. Pp. v+99. 20 cents. Water-Supply Paper 650: Surface Water Supply of the United States, 1927. Part 10: The Great Basin. Pp. v+97. 20 cents. (Washington, D.C.: Government Printing Office.)

Contributions from the Jefferson Physical Laboratory and from the Cruft High Tension Electrical Laboratory of Harvard University for the Years 1928 and 1929. Vol. 20. 62 papers. (Cambridge, Mass.)

Bernice P. Bishop Museum. Bulletin 74: New Plants from Fiji, I. By John Wynn Gillespie. Pp. 99. Bulletin 75: Samoan Material Culture. By Te Rangi Hiroa (P. H. Buck). Pp. xi+724+56 plates. Bulletin 77: Hawaiian Proverbs and Riddles. By Henry P. Judd. Pp. 91. Bulletin 78: Report of the Director for 1929. By Herbert E. Gregory. Pp. 40. Special Publication 16: Proceedings, Hawaiian Academy of Science, Fifth Annual Meeting, May 1-3, 1930. Pp. 19. Memoirs, Vol. 11, No. 4: The Physical Characters of the Society Islanders. By H. L. Shapiro. Pp. 30+4 plates. Occasional Papers, Vol. 9, No. 1: Geology of Molokini. By Harold S. Palmer, with Notes on the Flora of Molokini by Edward L. Caum. Pp. 18. Occasional Papers, Vol. 9, No. 2: Notes on Polynesian Pounders. By L. J. Bouge. Pp. 11. Occasional Papers, Vol. 9, No. 3: New Hawaiian Species of Pipturus. By Vladimir Krajina. Pp. 6. Occasional Papers, Vol. 9, No. 4: New Polynesian Plants. By Forest B. H. Brown. Pp. 28. Occasional Papers, Vol. 9, No. 5: New Hawaiian Plants. By Edward L. Caum. Pp. 30. Occasional Papers, Vol. 9, No. 6: New Hawaiian Medusae. By Charles Howard Edmondson. Pp. 16. Occasional Papers, Vol. 9, No. 7: Effect of Ultraviolet Rays in Regeneration of Chelipeds. By Charles Howard Edmondson. Pp. 7. Occasional Papers, Vol. 9, No. 8: The Problem of Polynesian Origins. By E. S. Craighill Handy. Pp. 27. Occasional Papers, Vol. 9, No. 9: Notes on Tongan Ethnology. By J. D. Whitcombe. Pp. 20. Occasional Papers, Vol. 9, No. 10: New Hawaiian Crustacea. By Charles Howard Edmondson. Pp. 18. Occasional Papers, Vol. 10, No. 11: New Species of Partula. By C. Montague Cooke, Jr., and Henry E. Crampton. Pp. 9. (Honolulu.)

Evidence on the Nature of the Elementary Magnet from Researches on Gyromagnetic Phenomena. Faculty Research Lecture at the University of California at Los Angeles delivered April 20, 1928, by Prof. S. J. Barnett. Pp. 48. (Los Angeles, Cal.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 10: Morphology of the Bark Beetles of the Genus Gnathotrichus Eichh. By Karl E. Schedl. (Publication 3063.) Pp. 88. (Washington, D.C.: Smithsonian Institution.)

Publikace Pražské Státní Hvězdárny (Publications de l'Observatoire National de Prague.) No. 7: Sur la théorie ellipsoidale de Schwarzschild. Par Dr. V. Nechvíle. Pp. 15. (Prague.)

Proceedings of the Imperial Academy. Vol. 6, No. 10, December. Pp. xxix-xxx+385-480. (Tokyo.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 82: The Orthoptera of Alberta. By Morgan Hebard. Pp. 377-403. The Land Snail Genus Haplotrema. By H. Burrington Baker. Pp. 405-425. (Philadelphia.)

Proceedings of the American Philosophical Society. Vol. 69, No. 8. Pp. xix+529-580. (Philadelphia.)

United States Department of Agriculture Circular No. 129 Survey of the Fertilizer Industry By P E Howard Pp. 28 5 cents Technical Bulletin No 228 Character of the Colloidal Materials in the Profiles of certain Major Soil Groups. By M S Anderson and Horace G Byers Pp 24 5 cents Farmers Bulletin No 1654 Insects of the Pecan and how to Combat Them By G F Moznette, T L Bissell and H S Adair Pp ii+60 15 cents Leaflet No 65 Red-Squill Powder in Rat Control By James Silver and J C Munch Pp 6 5 cents Technical Bulletin No 229 Variations of the Colloidal Material extracted from the Soils of the Miami Chester and Cecil Series By R S Holmes and Glen Edgington Pp 24 5 cents. (Washington, D C Government Printing Office)

Statens Meteorologisk Hydrografiska Anstalt Årsbok 10, 1928 iii Vattenständen vid Rikets kuster Pp 22 2 00 kr Årsbok 11, 1929 v Hydrografiska matningar i Sverige Pp 18+4 planscherna 3 00 kr Årsbok 11, 1929 vi Aerologiska iakttagelser i Sverige Pp 40 3 00 kr Meddelanden, Band 6, No 1 Norrskensfotogrammetri i Abisko under Februari och Mars 1922 Av Hjalmar Hammarén Pp 17+9 planscherna 2 50 kr Meddelanden Band 6, No 2 Vegetationens utveckling i Götaland Av Knut Arnell och Sigfrid Arnell Pp 70 3 50 kr (Stockholm)

U S Department of Commerce Bureau of Standards Research Paper No 235 Efficiency of Production of X Rays By Warren W Nicholas Pp 843-865 10 cents Bureau of Standards Journal of Research Vol 6 No 1, January Pp 182 (Washington, D C Government Printing Office)

New York State College of Home Economics at Cornell University, Ithaca, New York Fifth Annual Report, 1930 Pp 108 (Ithaca, N Y)

Cornell University Agricultural Experiment Station Bulletin 513 The Chemical Composition of New York Soils By J A Bizzell Pp 25 Bulletin 514 Soil and Field Crop Management for Chenango County New York By A F Gustafson H O Buckman and H P Cooper Pp 81 Memoir 134 Lysimeter Experiments 3 Records for Tanks 3 to 12 during the Years 1910 to 1924 inclusive By T L Lyon J A Bizzell B D Wilson and E W Leland Pp 72 (Ithaca, N Y)

Proceedings of the California Academy of Sciences Fourth Series Vol 19 No 12 Pelagic Mammals from the Temblor Formation of the Kern River Region California By Remington Kellogg Pp 217-397 (San Francisco) 1 25 dollars

Annales de l Institut de Physique du Globe de l Université de Paris et du Bureau central de Magnétisme terrestre Publiées par les soins de Prof Ch Maurain Tome 8 Pp iv+149 (Paris Les Presses universitaires de France)

Comité National Français de Géodésie et de Géophysique Section de Magnétisme et Electricité terrestres Nouveau réseau magnétique de la France au 1er janvier 1924 Memoire 2 Distribution générale des éléments magnétiques en France formules représentatives, definition numérique des anomalies Par E Mathias, Ch Maurain et L Eblé (Extrait des Annales de l Institut de Physique du Globe de l Université de Paris Tome 8 1930) Pp 37-62 (Paris Les Presses universitaires de France)

Conseil Permanent International pour l Exploration de la Mer Rapports et Procès-verbaux des réunions Vol 70 Rapport atlantique 1929 (Travaux du Comité du Plateau continental atlantique) Publié avec l aide de Dr Ed Le Danois et Rafael De Buen Pp 126 (Copenhague Andr Fred Høst et fils) 5 00 kr

University of Illinois Engineering Experiment Station Bulletin No 217 Washability Tests of Illinois Coals Conducted by the Engineering Experiment Station University of Illinois, in coöperation with the Zeigler Coal and Coke Company By Prof Alfred C Callen and David R Mitchell Pp 114 60 cents Bulletin No 218 The Friability of Illinois Coals By Cloyde M Smith Pp 29 15 cents (Urbana, Ill)

Bulletin of the National Research Council No 81 Industrial Research Laboratories of the United States including Consulting Research Laboratories Fourth edition, revised and enlarged Compiled by Clarence J West and Callie Hill Pp 267 (Washington, D C National Academy of Sciences)

Carnegie Institution of Washington Annual Report of the Director of the Department of Terrestrial Magnetism (Reprinted from Year Book No 29 for the Year 1929-30) Pp 249-322 (Washington, D C Carnegie Institution)

Proceedings of the United States National Museum Vol 78, Art. 15 Notes on some Acalyptrate Flies in the United States National Museum By John R Malloch (No 2858) Pp 32 (Washington D C Government Printing Office)

Meddelande från Lunds Observatorium No 124 Über die Bestimmung der Fehler von Mikrometerschrauben Von John Ohlsson Pp 4 No 125 Über die Bestimmung der Entfernungen Dimensionen, Massen und Dichtigkeiten für die nächstgelegenen anagalaktischen Sternsysteme Von Knut Lundmark Pp 18 (Lund)

U S Department of Commerce Coast and Geodetic Survey Special Publication 170 Chart Datums By H A Marmer Pp ii+40 (Washington, D C Government Printing Office) 10 cents.

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 104 The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Season 1926 to 1930, with a Discussion of Evasions of the Law By Dr W Lawrence Balls and Armenag Eff Bedevian Pp 28+28 plates (Cairo Government Press) 10 P T

The Science Reports of the Tôhoku Imperial University, Sendai Japan First Series (Mathematics, Physics, Chemistry), Vol 19 No. 6, December Pp. 631-800 (Tokyo and Sendai Maruzen Co. Ltd)

U S Department of Agriculture Farmers Bulletin No 1623 The Gipsy Moth and the Brown Tail Moth By A F Burgess Pp 33 (Washington D C Government Printing Office) 10 cents.

Scientific Papers of the Institute of Physical and Chemical Research Nos 282-285 Fat Soluble Vitamins in Tumor Tissues, by Midzuho Sumi and Waro Nakahara Über die Einwirkung der Kalilauge auf die Tetracarbonsäureester von Dimalonsäure Reihe (Darstellung von Aethyl Phenylpropionsäuren), von Hsiung Tsai Lo A new Radio-active Mineral found in Japan, by Satoyasu Iimori, Jun Yoshimura and Shin Hata. Pp. 69-88+4 plates (Tôkyô Iwanami Shoten) 45 sen.

Smithsonian Miscellaneous Collections Vol 85, No 1 Weather dominated by Solar Changes By C G Abbot. Hodgkins Fund and Roebling Fund (Publication 3114) Pp 18 (Washington, D C Smithsonian Institution)

State of Connecticut Public Document No 24 Fifty third Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1929 Pp. xiii+926+lxi (New Haven Conn.)

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 3, No 1 2 Janvier février Numéro commémoratif en l honneur de Professeur Frantisek Wald Pp 134 (Prague Regia Societas Scientiarum Bohemica.)

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 82 Cirripedia (*Balanus*) from the Miocene of New Jersey By Henry A. Pilsbry Pp 429-438 (Philadelphia)

United States Department of the Interior Geological Survey Water Supply Paper 633 Surface Water Supply of the United States, 1926 Part 12 North Pacific Slope Drainage Basins B Snake River Basin Pp vi+263 (Washington, D C Government Printing Office) 40 cents

U S Department of Commerce Bureau of Standards Circular of the Bureau of Standards, No 389 The Making of Mirrors by the Deposition of Metal on Glass. Pp 17 (Washington, D C Government Printing Office) 5 cents

CATALOGUE.

Catalogue of Scientific Books and Publications of Learned Societies. (No 304) Pp 74 (Cambridge W Heffer and Sons Ltd)

Diary of Societies

MONDAY APRIL 6

INSTITUTE OF CHEMISTRY (Leeds Area Section) (jointly with Society of Chemical Industry Yorkshire Section) (at Leeds) – Dr H J Channon Modern Aspects of Nutrition

TUESDAY, APRIL 7

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (Annual General Meeting) (at Engineers Club, Manchester) at 7 – J W Rissik and H Rissik Heavy Duty Rectifiers and their Application to Traction Substations

WEDNESDAY, APRIL 8

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees Side Branch) (Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough) at 7 –Mr Groves Engineering and Metallurgy

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub Centre) (at University College Southampton) at 7 30 – I C Grant The Breaking Performance of High Power Switchgear and of a New Form of Quenched Arc Switch

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester) at 8 – Annual General Meeting

TELEVISION SOCIETY (at University College).

THURSDAY, APRIL 9

INSTITUTE OF MARINE ENGINEERS (Junior Section) at 7 – E R Chamberlain Developments in Powdered Fuel Burning

INSTITUTE OF METALS (London Section) (Annual General Meeting) (at 83 Pall Mall) at 7 30 —Discussion on The Effects of Re melting and the Use of Scrap

OIL AND COLOUR CHEMISTS ASSOCIATION (at 30 Russell Square W C 1), at 7 30 –W N Bowran Bitumens and their Use in Paints

FRIDAY, APRIL 10

ROYAL ASTRONOMICAL SOCIETY at 5 —L H Thomas A Criticism of Current Theories of Stellar Structure, and a Suggestion —H Roth The Density Distribution in Capella —Dr H Jeffreys On the Cause of Oscillatory Movement in Seismograms —S F Grace Tidal Oscillations in Rotating Rectangular Basins of Uniform Depth —G Shajn On the Behaviour of Certain Simple Multiplets in Stellar Spectra

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society) at 6

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers Club, Manchester), at 7 –Dr A. E Dunstan The Present Position of the Thermal Decomposition of the Lower Hydrocarbons.

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall, Manchester) at 7 —Annual Meeting

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College Cardiff), at 7 15 —Annual General Meeting

JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—F Russell Difficulties in Power Transmission by Belt and how to overcome them

SATURDAY, APRIL 11

GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square, W C 1), at 2 30.—Sir Richard Gregory, Bart. Comets and Shooting Stars (Lecture).

PUBLIC LECTURES.

WEDNESDAY, APRIL 8

ROYAL HORTICULTURAL SOCIETY (at Greycoat Street, S W 1), at 3.30 — Prof E Baur New Scopes and New Methods of Plant Breeding (Masters Memorial Lecture)

THURSDAY, APRIL 9

ROYAL HORTICULTURAL SOCIETY (at Greycoat Street, S W 1), at 3 30.— Prof E Baur The Problem of Evolution (Masters' Memorial Lecture)

SATURDAY, APRIL 11, 1931

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Research and Industrial Revival.

AMONG the duties charged on the Advisory Council for Scientific and Industrial Research is that of advising on steps to be taken for the advancement of trade and industry by means of scientific research It was therefore inevitable that in a year of such persistent industrial depression and unemployment, the Advisory Council should be concerned with means by which science could assist in larger measure the restoration of our industries to full health While the diagnosis of our present difficulties lies outside its scope, the latest report of the Advisory Council (Cmd 3789) does not hesitate to assert that the increased use of scientific knowledge and scientific methods by our competitors abroad has been an important factor in the loss of our pre eminent industrial position

No spectacular results characterise this report, and their absence tends rather to emphasise the immense and far reaching contribution which the work of the Department of Scientific and Industrial Research is quietly making in every section of our industrial and national life While, however, there are many industries which have come to realise that our industrial position cannot be recovered unless our natural advantages are exploited to the full and all agencies available are employed for increasing our efficiency, the report affords no warrant for an easy optimism that the importance of research has been generally or even adequately appreciated either in industry or in the State

It is not merely that there are still many firms which are prone to reduce expenditure on research at the first signs of financial stringency and to forget that it is in times of slack trade that research for future developments is of most importance The case of the William Froude National Tank provides a pertinent example of the danger of this attitude As is stated in the report of the Advisory Council, owing to the increasing demands of testing work it had become almost impossible to continue research work in the William Froude Tank constructed at the National Physical Laboratory in 1909–10 through the generosity of Sir Alfred Yarrow The Council accordingly had recommended that a second tank should be erected for research in connexion with ship resistance and propulsion, and for tests on ship forms, propellers, etc , half the cost of which, up to £10,000, should be borne by the Department

While the depressed condition of the shipping and shipbuilding industries may be the cause of the unsatisfactory response to this offer, it cannot

be regarded as an explanation In consequence of the congestion of work in the existing tank, not only was research being hindered, but also orders for testing were accumulating to such an extent that they were frequently withdrawn and sent to the Continent, where in recent years similar facilities have greatly increased It is obvious that if the testing of ship designs is better carried out abroad, orders for construction are likely to follow them abroad By its failure to respond to this offer, the shipping industry clearly was committing suicide, and had not the Advisory Council, in view of the vital importance of this industry to the nation, revised its recommendation and suggested that the whole capital cost of a new tank should be provided initially by the State, the depression in the shipping and shipbuilding industries must inevitably have increased to a point from which any recovery in competition with Continental rivals would have been impossible

The shipping and shipbuilding industries can only be conducted with economy and efficiency if scientific knowledge is applied adequately and at the right time The demand for tests indicates that this is partly realised by the industry, but the rather discreditable episode demonstrates that the scientific outlook does not exercise a decisive influence on the direction of the industry In fact, the industry betrays a tendency to depend upon the State for assistance that should rightly be provided by its own efforts, the debilitating influence of such aid upon individual *moral* has been the most unfortunate result of much otherwise valuable legislation in social reform

Praiseworthy as have been the efforts of the research associations and valuable the results already achieved, the Advisory Council records that here again its chief anxiety is as to the financial stability of these associations This opinion is noted in spite of conclusive demonstration that the greater application of science to industry through such associations is one of the most important factors in industrial recovery While the Advisory Council looks to a time when research associations will be able to dispense altogether with financial assistance from the taxpayer, it is pointed out that the taxpayer benefits directly from such industrial research, which is gradually raising the standard of living

The problem, indeed, is not entirely one of financial support, for some research associations are at the moment actively seeking not so much to achieve further results as to secure the utilisation of those already obtained by the industries they serve To further this, development sections have been organised by a number of research associations, and the Advisory Council recommends that adequate provision should be made for the maintenance and extension of such work It is, of course, the closer contact between the management of research and production inherent in the organisation of research departments by large industrial firms which gives such departments a decided advantage over the research association The latter is essentially designed for the benefit of those firms unable to bear the full cost of such a research organisation and the cost of investigating fundamental principles, and the success of the research association largely depends upon the willingness of the members of the association to co operate in the submission of both information and problems as well as in the utilisation of results

The evidence indicates that a disconcerting lack of appreciation of the fundamental importance of scientific research and even of the value of co operation still pervades important sections of our basic industries Under modern conditions, the idea of trade secrecy still cherished by a few of our industries has lost its value, and trade secrets are never long hidden from the scientific investigator Development now depends on co operation and the prompt application of accurate knowledge, and until these habits of co operation and research have been acquired by such industries, their recovery inevitably lags and the position of the research associations remains precarious

Not the least serious effect of such unstability is that exerted upon the recruitment of the scientific staff It is of the utmost importance to our industrial future that men of proved scientific ability should be recruited and retained for industrial research of this type This cannot be secured if the financial position of the research workers is not reasonably assured, nor indeed can we expect the most efficient work if their minds are disturbed by serious financial uncertainty The Advisory Council strongly urges the support of superannuation under the Federated Superannuation Scheme of the Universities, which allows a man to contribute for the future irrespective of his continued employment at a particular institution

On the more effective organisation of support for research associations generally, the advantages of a compulsory levy are indicated, and the Advisory Council urges the consideration of such methods by the research associations, and

expresses the hope that if statutory authority is necessary, Parliament will place industries in a position to provide the necessary funds when a sufficiently large majority of the firms in any industry express their desire for the imposition of such a levy Before, however, any such levies could be arranged, it would appear that a very much wider education of the industries concerned on the importance of scientific research and its relation to industrial development is required The growth of co-operation appears to be hindered by the same forces which have delayed the much-needed rationalisation and reconstruction of some of our basic industries, and here again their removal is largely dependent on education The report of the Department of Scientific and Industrial Research provides invaluable material for such an educational campaign, and at the present time should be used to the utmost by all who are concerned not merely with the restoration but also with the expansion of our industries

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Radio Principles and Practice

(1) *Elements of Radio Communication* By Prof John H Morecroft Pp x + 269 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 15*s* net

(2) *Radio Telegraphy and Telephony a Complete Textbook for Students of Wireless Communication* By Rudolph L Duncan and Charles E Drew Pp x + 950 (New York John Wiley and Sons, Inc., London Chapman and Hall, Ltd , 1929) 37*s* 6*d* net

(3) *Radio Traffic Manual and Operating Regulations* By Rudolph L Duncan and Charles E Drew Pp ix + 187 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 10*s* net

(4) *Radio Data Charts a Series of Abacs providing most of the Essential Data required in Receiver Design* By Dr R T Beatty Pp 82 (London Iliffe and Sons, Ltd , 1930) 4*s* 6*d* net

THE professional worker in radio telegraphy is sorely embarrassed by the natural and simple request so often addressed to him by his non-specialist friends, "Tell me what book on wireless I ought to read, so that I may have an intelligent appreciation of what is happening in and behind my broadcast receiver" He is unable conscientiously to prescribe any single book that will tell the whole story, reasonably fully, in due proportion, and in a language suited to the reader with a general education A general education must not be assumed to include advanced physics, mathematics, electrical engineering, meteorology, solar physics, and the like He may feel that he would like to write such a book it could be done now with some show of authority, of definiteness, and of simplicity , but he has his daily work to do, and so he turns hopefully to each new book list The spate of deplorably inadequate popular expositions which was released by the advent of broadcasting is now happily abated , books, such as these before us, may be expected to contain an informed and balanced survey of the fields indicated in their titles Is one of them the book for his listening friends ? Or for himself ?

(1) Those who know Prof Morecroft's larger volume come to his newer book with a high standard already set This "general review of those parts of the alternating current theory which are of fundamental importance in radio, followed by the specific application of these principles to radio telegraphy and telephony", comes near to being a very good book indeed Its greatest merit is that it is never misleading It omits some things that one would like to see discussed, but the matters selected for discussion are well proportioned, interestingly treated, and quantitatively estimated Its greatest demerit is that the author's familiarity with the concepts of the art leads him to forget at intervals the standard which he assumes for his readers, so that while generally he gives detailed elementary discussions of fundamental phenomena, at times he confronts the student, devoid of "mathematical preparation more advanced than algebra", with unexplained novelties such as uniformly rotating vectors, lagging currents, hysteresis, mutual induction, microvolts per metre, envelopes, and so on Its second fault is that undue compression leads to loss of clarity One feels that a five per cent increase in bulk would give a twenty per cent increase in intelligibility and accuracy For example, the statement that "the number of complete cycles of flow is called the frequency of the current" is inexcusably lax Again, "coefficient of coupling" is introduced as a purely magnetic quantity, without any warning that capacitative couplings are of profound importance in every broadcast receiver

The concluding part of the book describes typical apparatus, and is satisfactorily definite about numerical values Ten pages of 'problems' at the end will be useful to the serious student The book is delightfully produced and pleasing to handle The block-maker might, however, in the next edition allow us to read the graduations on

the footrules set up beside pieces of apparatus to give the scale

(2) The larger work by Messrs Duncan and Drew, more ambitious in title, and apparently wider in scope, is much less satisfactory in execution At the best it reaches a level of pedestrian usefulness to the operator of some specific commercial sets, and at the worst it comes dangerously near sheer nonsense The over all effect is extremely irritating Four pages of instruction on the care of the motor generator do not make amend for this astonishing picture of a magnetic field

"The lines along which the filings are arranged are known as 'lines of force' The lines of force leaving the north pole re-enter the magnet at the south pole, and are considered as having travelled through an infinite amount of space medium from the time they left the north pole until they re enter the south pole The lines of force which issue forth from a weak magnet supposedly extend as far distant as those from a strong magnet, but since, in the latter case, the lines of force are unable to get far away from each other, they are packed very closely together because they occupy the same space medium as the lesser number of lines which issue from the weaker magnet A magnetic field of great density possesses great strength, and the strength of a magnet is dependent upon the closeness of the lines of force rather than the distance they extend"

Nor does the appearance of meticulous care in the prescription of No 100 carborundum and oil for grinding quartz crystals offset the carelessness of the statement, on the same page, that "the oscillations are produced at a very high frequency, proportional to the crystal's thickness"

The physicist will be startled by the statement, "A molecule, however, is composed of *atoms*, millions of them, about which *electrons* are presumed to revolve" The mathematician will be no less startled by "Fig 59—A logarithmic curve", which has a constant slope from the origin to abscissa 5 and zero slope from abscissa 12 onwards Neither will be startled by the statement, " . a temperature of absolute zero This, of course, is an extremely low temperature" .

The only way in which the authors might make a passably good book out of this volume would be to reduce it explicitly to be a book of detailed instruction in the use of named apparatus, and to avoid any attempt to explain principles

(3) The scope of this paper-covered volume is thus defined in the authors' foreword "Government and commercial traffic rules and regulations prescribe the manner in which radio communications shall be handled These operating instructions are embraced in this volume, with other instruction, which should be followed as closely as actual conditions permit A uniform procedure in moving radio messages should be the aim of professional radio operators" It comprises six chapters, dealing respectively with Acquiring the code—Use of "Q" signals Operating rules and regulations of the Radiomarine Corporation of America International Radiotelegraph Convention U S Radio Act of 1927 Ship Act of July 23, 1912 Regulations governing the issuance of radio operators' licences While much of the text is, naturally, concerned with American conditions, the peculiarly international character of wireless communications makes this book of use to wireless operators of other countries

(4) The modesty of price of this valuable work is equalled only by the modesty of its title The avowed purpose of the book is to give the wireless designer a ready means of solving his problems without recourse to complicated formulæ and mathematics But the student who is wise enough to forget that it is a handbook and to take it as a supplementary text book will find that, in working through its thirty nine abacs with the explanatory notes attached to each, he has acquired at once a familiarity with and a respect for the nomogram as a powerful aid to quantitative design in any field, and a sound knowledge of the principles of quantitative design in the field of wireless

The general reader will probably be pleasantly surprised to find how completely the design of wireless receivers has been lifted out of the 'trial and error' state in which it remained for many years The reader who does not require conversion to belief in the abac as a labour-saving device, will yet find food for admiration in the ingenuity which has been exercised to permit the use throughout the book of standard straight-line logarithmic scales, aided where necessary by ungraduated curves to which the ruler or other alignment indicator is made tangent in the setting The publishers might well include, in the new edition which will certainly be called for, a transparent scale on thin celluloid, which is much more convenient for use than the opaque implement suggested by the instruction to use a 'ruler' for alignment

The only faults which have been detected in this carefully arranged work are very minor ones The numbering does not appear to be entirely systematic there is an abac No 18 and a No 18*a*,

No 19 has "stage 1", "stage 2", and "stage 3", represented by separate sheets, while Nos 24*a* to 24*e* have no No 24 associated with them Perhaps more important is the misprint in No 22, where the relative transmission, in the case chosen to illustrate the use of the abac for "Transmission of sidebands by a tuned circuit", is stated to be 0 447 instead of 0 707

The author and his publishers are to be congratulated on the production of a work representing amazingly good value for money

To sum up, the book for the professional worker is certainly Dr Beatty's, and the professional worker's inquiring friend will find it wholesome, if concentrated, meat The friend will find Prof Morecroft always interesting, never misleading, but sometimes incomprehensible, he will find Messrs Duncan and Drew frequently misleading, and too speciously comprehensible to be safe

Science in Literature

H G Wells a Sketch for a Portrait By Geoffrey West Pp 316 (London Gerald Howe, Ltd, 1930) 10*s* 6*d* net

IF the function of a biographer is to produce a living picture of his subject for his own and future generations, he will not have succeeded in his task unless he himself fades completely in word and in spirit from the pages of his biography In providing us with this story of the struggles of a great man, Mr Geoffrey West has done his work well, for as we turn over the pages of this volume and live through the intimate history of Mr H G Wells, the authorship of the work itself drops completely from our ken This is as it should be, and thus an excellent portrait has been produced

Those of us who are now struggling through the lean and hungry forties and can look back on their early youth, twenty or more years ago, inspired as it then was by the glamour of the scientific romances and of the social philosophy of Mr H G Wells, are not likely to forget the debt which they owe him The rising generation of the 1900's, caught between a decaying Victorianism and a rebellious modernism, threw itself with energy into the fight for what it, in its early enthusiasm, called Progress Manhood may mature the judgment, or temper the impatience of youth, but if the altered values of this post-War age in matters of convention and social outlook are at all to be associated with the activities of any group of men, eminent among that band must be the early Wells

The story of the man is no tale of a silver spoon Born and bred in respectable poverty and Victorian gentility, dogged by persistent ill-health, he staggered through many vicissitudes, from inefficient drapery assistant through overworked private school teacher, to the feet of Huxley at South Kensington There early he saw a vision of science in the service of man, and he pursued it relentlessly Material success came to him, but the vision remained a vision

In a sense, one need not produce a biography to reveal the history of a writer A craftsman proceeds straight from experience, and the writings of Wells reflect the structure of the man A pioneer in scientific fiction, he quickly sensed the dramatic element in a field that had not so far been exploited at all, and so he insinuated into the minds of his readers the amazing possibilities of science Throughout thirty years of strenuous writing, there runs this extraordinary thread of continuity in his work—the same theme—that the universal solvent of ignorance is scientific knowledge, scientifically applied this, whether the problem be moral or pedagogic, social or industrial, national or international To the young men who grew up in this hectic period of problem play and problem novel, he was at once a strength and a goad As boys, we passed easily from the schoolboy "Dormitory Flag" stage, to Wells and the "Time Machine", "War of the Worlds", and "When the Sleeper Wakes" A new universe stood revealed before us, a universe of science and imagination, a world of dizzy possibilities It remained only to give direction to this awakened fervour, to set this torch to the ready sense of social and industrial injustice, in order to fire the reformist and inflame the revolutionary spirits of the younger generation "Anticipations", "Mankind in the Making", "A Modern Utopia", "This Misery of Boots", "New Worlds for Old", "First and Last Things", came in hammering succession, and the younger men became violent propagandists, a nuisance to friends and foes alike

As we look back on these easily impressionable years, it is amazing to recognise the uncanny gift of the man He said the things we ached to say His work may date, but it was ripe, just ripe, for its time Wells has never claimed to be more than a journalist, but if so, his journalism was unique

The middle period of Wells is a tale of adolescent struggles, of the scientific exposure of sex, and of a determination to accustom the mind of the reading public to think boldly and openly of the matter, as one would of any scientific problem In this he fought not merely a narrow Victorian convention,

but also a taboo with its roots deep in man's early history In the eyes of those who still have faith in the open discussion and scientific analysis of secret matters, to H G Wells must be given a great measure of credit for a great achievement

Times have changed and we have moved fast since those days, but the indefatigable Wells has effected some amazing revolutions He has multiplied the reading public many fold, he has forced it to read history in fat volumes and to study biology in the nude Beginning his career as an underling in a small private school, he has become the greatest public teacher now living

It is not easy to judge his later activity In an atmosphere of sullen suspicion and industrial chaos, an aftermath of five years of slaughter, he is still idealist enough to pin his faith to international co operation, and yet realist enough to disavow political parties and the League of Nations And now at this stage, still yet in his prime, he projects a work on scientific economics The thread is still unbroken, the vision still beckons him on, but his young men are now mentally middle aged and disillusioned He has outlived them all, but the rising generation is equally disillusioned

H Levy

Movement of Solutes within the Plant

Die Stoffbewegungen in der Pflanze Von Prof Dr Ernst Munch Pp vii + 234 (Jena Gustav Fischer, 1930) 12 gold marks

IN recent years, this subject has again been much in the forefront of discussion, English readers will recall particularly Dixon's onslaught upon the efficiency of the phloem for downward movement of organic solutes, and Curtis's staunch advocacy of the capacity of this tissue to take not only sugars but even nitrates in any direction, as also the series of papers by Mason and Maskell upon the movement of sugar (see Nature, 123, pp 133-135) and nitrogen (see Nature, 126, pp 973-974) in the cotton plant, which supply valuable data which must be taken into account in any future attempt to elucidate the mechanism of movement of solutes in the plant

Unfortunately, Dr Münch, whose monograph on this subject seems in some respects to break new ground, is unaware of these recent papers by Mason and Maskell, but his contribution is interesting and suggestive, in part perhaps because the point of view is rather that of forest botany than purely academic botany, and one main service his monograph performs is to bring again under notice an earlier valuable contribution which was published in a forestry journal

Dr Münch's main thesis is that the system moving water and solutes in the plant may be conceived as consisting of two main components, which may be represented schematically as in Fig 1 On one hand is the lifeless, permeable woody system, full of water, and represented in this scheme by the vessel of water in which the semi-permeable cells A and B are immersed A and B represent semi permeable living cells, connected by a tube with porous, permeable plates at intervals, the sieve tube with sieve plates In the plant, A and B represent living tissues, abutting on the xylem, connected by phloem When A is at a higher osmotic pressure than B, water will be drawn into A and driven out of B, whilst

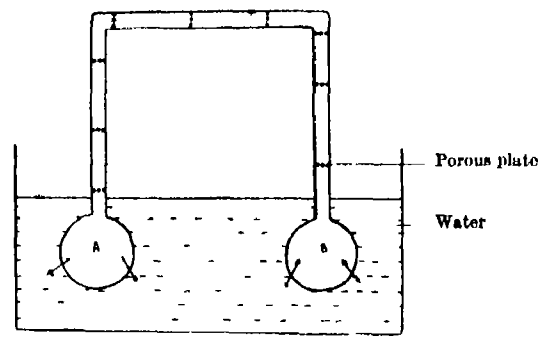

Fig 1

the contents of A will move along the connecting tube into B, so long as the concentration at A remains higher than in B In this manner sap at a higher concentration is drawn along the sieve tubes towards regions of lower concentration, from assimilating leaves, for example, downwards to the growing cambium or upward into a growing fruit

In this connexion, Münch recalls certain earlier experiments of T Hartig and describes interesting observations of his own, which demonstrate that if an incision is made into the phloem of the tree in summer, especially just prior to leaf fall, a definite exudation of sap occurs, sufficient quantities being obtained with patience to permit of some chemical analysis As these drops of sap exude, the pressure in the sieve tube rapidly falls, especially below the cut, so that no more sap exudes from other cuts above and below for a certain distance, which is often much greater below than above These experiments certainly demonstrate the existence of a positive pressure in the contents of the sieve tubes of the current year's growth, but for the system Münch postulates, the flow after

incision seems very slight, and certainly there is little evidence of the vigorous flow through the uncut sieve tubes, as a result of this osmotic, hydraulic mechanism, which the author seems to think is taking place

The sugars moving downwards in the phloem have to reach this tissue from the assimilating cell of the leaf, and Dr Münch tackles anew this great stumbling block in translocation theories How does sugar, so slow in penetrating the normal living cell, manage to move so quickly from the green assimilating cell of the leaf mesophyll into the veins and thus out of the leaf? Dr Münch suggests that the sugar movement may be brought about by different osmotic pressures in adjacent cells, forcing the contents of one cell into the other along the protoplasmic connexions or plasmodesma The sugar in this case is assumed to be in the plasma, not in the vacuole, and to be forced through from cell to cell, moving in the plasma of the plasmodesma strand In the sieve tube, on the other hand, the vacuole is thought to be continuous through the larger pores in the sieve plate, and the sugar is thought of as moving with the water in the manner previously described

These distinctly unusual conceptions of solute movement are accompanied by calculations, based largely upon the assimilation rate of trees, rate of increment of wood, etc, which involve so many assumptions that their value is doubtful, though it is admitted that numerical tests should be applied to our theoretical ideas as to the mechanism of transport at the earliest possible moment But when the increment of wood in the season's growth is used as a basis upon which to calculate the amount of substance that has passed through the inner surface of the cambium by 'exosmosis', the reader may wonder whether the processes of growth and cell division, by which the original framework of these wood cells has been laid down, have not been too completely neglected

Dr Münch has probably done considerable service to botany by directing attention anew to these easily repeatable experiments, which demonstrate that the contents of the young sieve tubes are under pressure, and a pressure which apparently originates from above A re-examination of the possible rôle of the fine plasmodesma strands in the movement of substance in mass is also certainly required, but his monograph will probably not convey to most readers the impression that these problems are solved and the physical mechanism of movement of substances in the phloem now placed beyond doubt

Our Bookshelf

Als Naturforscher in Indien Von Prof Dr Hans Molisch Pp xii + 276 (Jena Gustav Fischer, 1930) 13 gold marks

Prof Molisch's book is a record of a visit to India in the winter of 1928–29 The visit was the outcome of an invitation from Sir Jagadis Bose to the Austrian plant physiologist that he should make his home at the Bose Institute in Calcutta, and that whilst studying the methods and ideals of this establishment, he should give occasional lectures to the workers on matters in his own field, and also carry out any research he desired During the course of the visit, Prof Molisch had full opportunity of seeing India, observing the customs of its peoples, its flora and botanic gardens His various experiences are set down in full, even with intimate detail, the result being rather heterogeneous Nevertheless, the movement, beauty, and sunshine of India continually find their way into the pages of a book generally loosely knit and lacking in construction The photographic illustrations (more than a hundred in number), which deal with all sorts of subjects, are a great feature, they are well selected and well reproduced, largely atoning for the author's lack of literary style Like many travellers, Prof Molisch finds it easier to take good landscapes, crowd pictures, and portrait studies of individuals than to produce good habit pictures of plants

The author deals faithfully with his mission as expounder of the work and inspiring personality of Sir J C Bose, though he does not always accept the precise conclusions that have been drawn Apart from these sketches of the activities of Bose, many chapters are devoted to the vegetation of India, especially from the biologist's point of view There are sections on leaf-fall, the water hyacinth nuisance, mangroves, ants, and numerous physiological and biochemical matters, as well as on botanic and other gardens In a sympathetic account of the Calcutta Botanic Gardens, an appeal for a laboratory, equipped for physiological work, is included Other sections deal with social observances, education, hygiene, and the present day ideals of India Besides a visit to Darjeeling (where Bose has a hill station), attractive accounts are given of some of the principal cities of India and the native State of Jaipur As a whole, the book shows observation, a capacity for being pleased, and a point of view which differs considerably from that of the ordinary tourist

F W O

Die Tierwelt der Nord- und Ostsee Begründet von G Grimpe und E Wagler Herausgegeben von G Grimpe Lieferung 17 Teil 2 d_2 *Peridinea*, von Nicolaus Peters, Teil 3 d *Scyphozoa*, von Thilo Krumbach Pp 13-84 + 88 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 13 50 gold marks

Dr N Peters, who has done much work already on the peridinians or dinoflagellates, gives a good and detailed survey of the group It is well known

that they combine holophytic with holozoic nutrition and therefore are claimed by both botanist and zoologist Some apparently feed exclusively as plants, others as animals, but many feed in both ways The larger naked forms engulf others of their kind, as well as diatoms and other small prey The presence of a large eye with well-developed lens in some of these and nematocysts in *Polykrikos* and others give a special interest to these unarmoured forms Here we find chain formation both in the naked and armoured species, and the beginning of a multicellular state in which individuals are permanently fused and the nuclei are fewer in number than the cells themselves There are many species known from the North Sea and Baltic, but not so many as there are in the Channel, possibly because the region has not been worked so much for these creatures All species are well figured and they are easy to identify We note the absence of *Noctiluca*, which is treated separately in another part of this publication

Dr Krumbach in his account of the Scyphozoa (Part 3 d) shows that of the five orders three are represented here—the Lucernarida with four genera and five species, the Semæostomeæ with four genera and four species, and the Rhizostomeæ with one genus and one species Structure, feeding, and reproduction are fully dealt with, and the author gives a very clear description of the various members of the Scyphozoa, which is well illustrated and up to date

(1) *British Prime Ministers of the Nineteenth Century* By Prof F J C Hearnshaw (Benn's Sixpenny Library) Pp 80 (London Ernest Benn, Ltd , 1930) 6*d*

(2) *Daily Life in Parliament* By H Snell (Routledge Introductions to Modern Knowledge) Pp 74 (London George Routledge and Sons, Ltd , 1930) 6*d* net

(3) *Sinon or The Future of Politics* By E A Mowrer (To day and To morrow Series) Pp 96 (London Kegan Paul and Co , Ltd , 1930) 2*s* 6*d* net

THESE books may suitably receive notice within one paragraph, being respectively concerned with political life of the past, the present, and the future Dr Hearnshaw deals succinctly, but engagingly, with the succession of premiers who guided the Empire's fortunes during a period commencing with Addington and concluding with Lord Salisbury, coincident with the closing of the Victorian era Mr Snell presents a description of the parliament of to day, sufficiently realistic to be welcome Mr Mowrer's contribution is necessarily on less secure ground, as it deals in surmises, based, it is true, upon a logical progression from existing facts and tendencies towards a conceivable future His remarks are cogent and well balanced "We cannot eliminate natural inequality ", " Standardised minds are a relapse of the race into the tribe ", " Under a rational system failure to vote would be penalised " The author's remarks upon Russia and Italy are worthy of close attention Perhaps not unreasonably, he is somewhat pessimistic—" Not for nothing was Sinon reputed the son of that Sisyphus condemned to perpetual stone-(or was it log) rolling ", " What is history but one long series of reforms that have failed ? " For the world as a whole, Mr Mowrer foreshadows internationalism as the over-riding government of to-morrow P L M

Couleurs (étude physique) et colorimétrie Conférence faite au Conservatoire National des Arts et Métiers le 7 mai 1930 Par Prof P Fleury (Conférences d'actualités scientifiques et industrielles, 12) Pp 34 (Paris Hermann et Cie, 1930) 5 francs

IN this lecture, the author points out the difficulties which the accurate specification of colour encounters owing to the physiological nature of the colour sensation He explains how a colour may be specified by the wave-length of its dominant radiation, its luminous flux, and its coefficient of purity, or alternatively by the trichromatic method, which specifies the luminous flux of each of three standard wave lengths, which together produce the colour sensation in question When the sensitivity curves of each of the three sensory elements of the normal eye to light of different wave lengths are known, one method of specification may be converted into the other The author describes the principles on which modern colorimeters are constructed, and states that those based on the trichromatic system are the simplest and suffice for many purposes He believes, however, that for accurate work a combination of a spectrophotometer and a colorimeter on the lines of the instruments of Nutting and of Priest is necessary He hopes that a laboratory for the study of colorimetry will be established in France which will compare with those already at work in the United States, in Great Britain, and in Germany

Simple Geological Structures a Series of Notes and Map Exercises By John I Platt and John Challinor Pp 56 (London Thomas Murby and Co , New York D Van Nostrand Co , 1930) 3*s* 6*d* net

IN this little book, which is of an elementary character, beginners are introduced to the three-dimensional conception of geology, a knowledge of which is essential to progress in the science The maps and sections figured, and the accompanying notes, are simple and straightforward So far as they go, they serve their purpose admirably A more extensive and varied use might, with advantage, have been made of the names of the major divisions of the geological succession In this way the student would, incidentally, be assisted in acquiring familiarity with their correct order of superposition In practice, geological maps are primarily constructed to show age-formational divisions rather than lithological bands

The illustrations represent ideal cases, and users of the book would do well to realise, as indeed the authors suggest in their preface, that in Nature the facts are seldom either so simple or so obvious

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Observations of a Low Altitude Aurora and Simultaneous Phenomena.

IN the afternoon of Nov. 16, 1929, during my stay in Abisko in northern Sweden (N. lat. 68° 21′) I observed a rather intensive auroral ray of about 10° apparent length and about ½° apparent breadth in the west-south west *below a completely cloudy sky*. The exact time of the first observation was $16^h\ 18^m$ G.M.T. After about one minute the ray disappeared, but later it appeared and disappeared several times during an interval of about ten minutes. The colour was reddish-yellow. No sound was heard.

The clouds, apparently situated behind the ray, were of stratiform alto cumulus type and consisted of apparently thin and thick strata. The ray began in or in front of a thin stratum, crossed over a thick (more dark) stratum *without appearing less intense here*, and vanished in or in front of the next thin stratum. In the east, similar clouds covered almost completely the sky and *also the full moon*, which was visible only a few times between the clouds. Examining carefully the facts mentioned above in italics, I could not escape the conclusion that the auroral ray must be *below the clouds*, that is, at only a few thousand metres above the ground. On the other hand, it is well known that observations of low altitude auroræ are considered very doubtful and have not yet been confirmed photographically.

A few days later, Mr. Linus Eriksson, at Abisko, told me that he and some other railway employees in Abisko had observed the same auroral display about an hour earlier than I, and also noticed its appearance in front of the clouds. Also, two Norwegian engine drivers on the railway between Abisko and Narvik in Norway had observed the same phenomenon. A report of our observations was sent to Prof. Carl Størmer in Oslo and to the Meteorologisk Hydrografiska Anstalten in Stockholm. In his reply, Prof. Størmer very much regretted that the auroral ray had not been photographed from two places of observation, so that its parallax could have been obtained. A visual observation cannot contribute much more to the most important question if low altitude auroræ really exist than many other similar observations reported earlier. This observation of a low altitude aurora in Abisko on Nov. 16, 1929, has been printed in Swedish and French among my other auroral observations during the period September-December 1929 in "Observations météorologiques à Abisko en 1929", but as I did not wish to increase the number of doubtful observations, it has not been published more exhaustively elsewhere until now.

Reading the most interesting communication of Mr. G. C. Cummings in NATURE of Jan. 17, 1931, p. 108, about a low altitude aurora observed by his brother in Norwood, Ontario, Canada, "early in the winter 1929–30", I inquired the exact time of Mr. Cummings's observation. G. C. Cummings, writing from the Bell Telephone Laboratories in New York, has kindly replied to me in a letter, from which I quote the following lines: "Having received a number of letters from various parts of the world in regard to this Auroral display, it seemed rather important to attempt to establish the exact time of the phenomenon. Accordingly, I communicated with my brother and pointed out the desirability of this proceeding and have just received his reply. As nearly as he can establish it, the time was nine hours thirty minutes in the evening, Nov. 16, 1929, E.S.T. The phenomenon was observed by a number of people, among whom was a telegraph operator who remembered having delivered a certain telegram at the time he observed the Auroral display. Going back through the telegraph files, he located this telegram and was thereby enabled to fix the time within a few minutes. I believe that at least two of the observations reported are almost identical to that witnessed by my brother."

$9^h\ 30^m$ P.M. Nov. 16, E.S.T., is, however, $2^h\ 30^m$ A.M. Nov. 17, G.M.T., so that if Mr. Cummings observed the auroral display in the evening, it was about ten hours later than my observations in Abisko. If, on the other hand, Mr. Cummings's observation was made $9^h\ 30^m$ A.M. on Nov. 16, it was very near the time of the first observations of the auroral display in Abisko. Still, even if the observations have a difference of 10 hours in time, it is very remarkable that low altitude auroræ have been observed on the same day at places so widely distant, and these observations are worth attention and further investigation.

I have therefore also examined the magnetograms of the geophysical observatory at Abisko and my readings of the ionisation in a Kolhörster ionisation chamber,[1] with regard to the time, Nov. 16, 1929. Magnetic disturbance began with a pronounced *impetus* already on Nov. 15, $19^h\ 0^m$ G.M.T., and went on until midnight of Nov. 16. No very great disturbance occurred, however, before $14^h\ 24^m$ G.M.T. on Nov. 16. At this time the vertical intensity gradually decreased and showed a maximum negative disturbance of more than −640 gamma at $15^h\ 16^m$, when the record during a few minutes exceeded the limit of the magnetogram. At $15^h\ 0^m$ the declination made a deviation of 1° 57′ towards east, but turned immediately and made a deviation towards west, which at $15^h\ 16^m$ exceeded the limit of the magnetogram, that is, made an angle towards west larger than 1° 32′. Thus the total oscillation of D during 16 minutes was larger than 3½°. On the other hand, the horizontal intensity did not show any extraordinarily large oscillations. The extraordinarily large deviations in Z and D coincide in time approximately with the first observations of the low altitude aurora of the railway employees in Abisko. At $1^h\ 50^m$ A.M. Nov. 17, G.M.T., a small disturbance occurred, namely −58 gamma in H, 10′ east in D, and +33 gamma in Z.

The following readings of the ionisation were made on Nov. 16, 1929, in Abisko. The values of I, or pairs of ions per c.c. and second, have been corrected for the 'barometer effect' and are valid for the mean air pressure, 720 mm. mercury, whereas those published in Fig. 1 on p. 57 of NATURE of July 12, 1930, were valid for air pressure of 760 mm. mercury.

	G.M.T.	I
Nov. 16	$5^h\ 34^m$ – $7^h\ 4^m$	2·56
,, ,,	7 4 – 9 3	2·68
,, ,,	9 3 – 11 13	2·69
,, ,,	11 13 – 13 23	2·72
,, ,,	13 36 – 17 7	2·83
,, ,,	17 7 – 20 19	2·74
,, ,,	20 19 – 22 1	2·57
,, ,,	22 1 – 23 46	2·58
,, 17	0 0 – 6 58	2·55

They show a maximum ionisation at the time of the observed auroral display, which is also in accordance with the result found from the observation in Abisko that there is an increase in the ionisation (measured at 388 metres above sea level) during the auroræ and

mentioned in more detail in Lund Observatory Circular No 1, 1931 Usually this increase is only 6 per cent

It is very desirable that the other observations of the low altitude aurora on Nov 16, 1929, mentioned by Mr G C Cummings should be published and that all observations should be compared

AXEL CORLIN

The Observatory, Lund, Mar 12

[1] Cf Nature July 12 1930 p 57

Measurement of the Electricity Liberated during the Downgrade Reactions of Organic Compounds

THE liberation of electricity during certain reactions of organic compounds has been well established in previous investigations * In the fermentation of cane sugar by yeast, it was shown that the amount of electricity liberated is proportional to the temperature and concentration of the sugar solution and to the number of active yeast cells, and is only liberated under conditions favourable to the growth of the yeast It was also demonstrated that electricity is liberated during the action of diastase and invertase and during the decomposition of organic matter by bacteria It is suggested that the apparatus employed might be termed a 'fermentation cell'

The following briefly describes a method of measuring this electricity based upon the laws of the electro deposition of metals The apparatus (Fig 1) consisted of a container A (porcelain vessel or wooden box) to hold the research material, in which was embedded a porous pot B containing a solution of copper sulphate, and an electrode C A wire D firmly connected to C terminated in a hook F, from which a copper wire E was suspended in the solution in B In order to localise any deposit of copper, the part of E immersed in the copper sulphate solution except a small area at the lower end, was insulated with shellac To serve as a control, a wire G similar to E, completely insulated except at the lower end, was suspended in B as in Fig 1 For C, carbon rods or rods of corrosion resisting steel, kindly given me by Messrs Hadfield, East Hecla, Sheffield, were used, as these electrodes resisted all chemical action by the research material

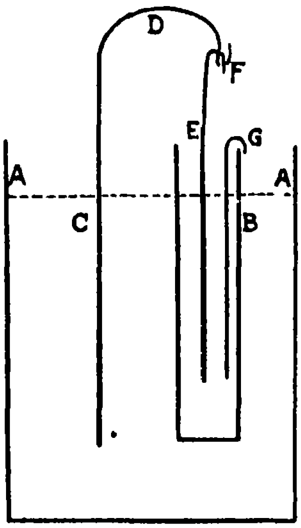

Fig 1

To test the apparatus, a weak solution of hydrochloric acid was placed in A and carbon electrodes used After 24 hours, no copper deposit could be observed upon the ends of either E or G This showed that no electric current had passed through the system When, however, zinc was placed in the solution in A without contact with either B or C, a copper deposit commenced to form upon the end of E, showing that an electric current was passing through the system The copper deposit increased as long as any zinc remained undissolved An experiment similar in all respects, except that the acidulated water in A was replaced by a 15 per cent solution of Barbadoes sugar, was left undisturbed for 48 hours After this period, a slight deposit of copper could be detected upon E with a lens, possibly due to bacterial action On the addition of yeast to the solution in A, fermentation set in and an evident knob of copper gradually formed upon the end of E (Fig 2) It will be allowed that the electro deposition of copper was due to the chemical action of the zinc and acid in the first case, and to that of sugar and yeast in the second

To test whether the copper deposit in the second case could be due to electricity liberated by the reduction of the copper sulphate by the dextrose and levulose in the walls of the porous pot, a fermentation cell was arranged with solutions of sugar of the same concentration in both A and B, and electrodes placed in A and B were connected to two wires dipping into a copper sulphate solution in a separate vessel After the addition of yeast to the solution in A, a copper deposit formed upon the wire connected to the electrode in A The fermentation cell may therefore be regarded as a primary cell, since the electrical effect cannot be attributed to leakage through the walls of B

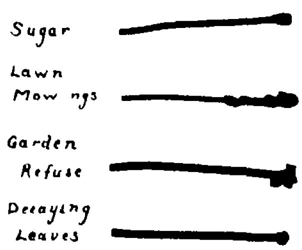

Fig 2

Experiments in which the research material consisted of freshly cut lawn mowings or fallen leaves pressed into a wooden box both showed a copper deposit upon E (Fig 2) As a further experiment, a corrosion resisting steel electrode and a porous pot B containing a solution of copper sulphate were sunk a few inches apart in a heap of garden refuse, the wire E dipping into B being connected with the electrode In this case also, copper was deposited upon E When the porous pot was removed some seven yards from the rubbish heap and the connexions maintained by an insulated wire, copper was again deposited, but much smaller in amount than when the electrode and porous pot were close together Thus it would seem that electricity is liberated in the decay of organic matter in the soil

Experiments show that copper is deposited during the hydrolysis of starch and sugar by weak sulphuric acid

Evidence for the liberation of electricity in the primary cell is given by the galvanometer and the electro deposition of metals Precisely similar evidence is afforded during the decomposition of organic compounds The fermentation of sugar and the decomposition of organic matter take place in a series of downgrade reactions from a higher to a lower potential, and experiments show that electricity is liberated by the enzymic activity of micro organisms during these reactions in a manner homologous to the liberation of electricity in a primary cell

Ordinary explanations to account for these electrical phenomena, such as differences of concentration, production of acid, or a high reducing agent round the electrode, are quite inadequate Any differences of concentration are due to the breaking down of organic matter and the consequent release of energy Moreover, certain of these reactions produce acids, others alkalis, and the heap of garden refuse was distinctly alkaline No further reducing agent is

* Potter, *Proc Roy Soc*, B vol 84 1911 *Proc Roy Soc* A, vol 91 1915 *Zentralbl. f Bakt*, Abt II, Bd 78, 1929 *British Med Jour*, Oct. 29, 1921

required than may be found in the enzymic activity during the hydrolysis of starch and sugar

The weight of copper deposit enables the weak electric currents to be accurately determined

M C POTTER

Corley Croft, New Milton, Hants,
Mar 10

Molecular Spectra of Mercury, Zinc, Cadmium, Magnesium, and Thallium

To obtain a general conception of the energy states of a loosely bound molecule, we have investigated the molecular spectra of mercury, zinc, cadmium, calcium, magnesium, and thallium in emission with an apparatus capable of concentrating excited molecules in a suitable quantity The photometric measurement of the photographic records obtained is summarised in Fig 1, in which the intensity of a continuous spectrum is denoted by a full line, and that of the region with some structure by a dotted line

From the results obtained, it may be generally stated that a 'band system' emitted from diatomic molecules of mercury, cadmium, zinc, and magnesium

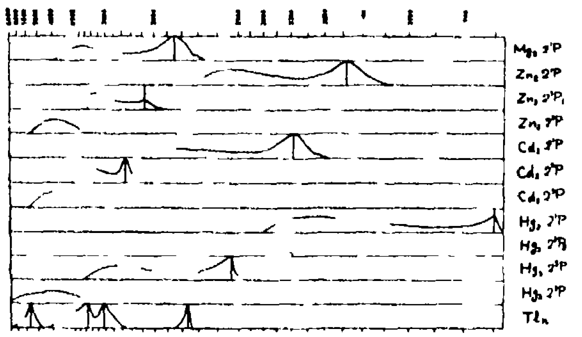

FIG 1

vapours has two broad maxima and one flat minimum of intensity One of these maxima always coincides with the resonance line $1\,^1S_0 - 2\,^1P_1$ or $1\,^1S_0 - 2\,^3P_{0,1,2}$ and the other lies at the region of longer wave length than this resonance line The intensity of the shorter wave length side from the resonance line gradually decreases and terminates rather suddenly at a certain position, while that of the longer wave length side from the second maximum decreases also gradually to a certain point where the band system suddenly breaks off or melts into the continuous spectrum of wide or narrow breadth In the region about this second maximum, there was found a generally coarse structure, the fluted bands occasionally consist of finer bands, while no bands were observed in the region near the resonance line The frequency of convergence of the coarser bands falls somewhere between the frequency of the resonance line and this frequency, plus the energy of dissociation in frequency unit

These experimental results and other details can be explained in the light of recent theoretical considerations put forward by Born Franck, Condon, Winans, and Kuhn, if we assume that the intensity maximum about the resonance line corresponds to that emitted by excited quasi molecules and the maximum on the longer wave length side to that emitted by excited stable (quantised) molecules

The energy of dissociation of a molecule in the normal or the excited states can be calculated approximately, as given in the accompanying table, from the difference of energies corresponding to the frequency of the resonance line and that of the shortest or the longest wave length limit of the band system These values for normal molecules evaluated in this manner are always a little greater than those already obtained by other observers For example, those for the molecules Zn_2, Cd_2, and Hg_2 are 0 29, 0 24, and $\geq$0 07 volt respectively, while Winans calculated them to be 0 25 and 0 20 volt for Zn_2 and Cd_2 from the limits of the absorption spectra, and Franck, Grotrian, and Koernicke as 0 04–0 06 volt for Hg_2 These discrepancies can be explained by taking into account the effect of the kinetic energies of colliding atoms at the temperatures of this experiment

	$1\,^1S_0$	$2\,^3P_0$	$2\,^3P_1$	$2\,^3P_2$	$2\,^1P_1$
Mg_2	0 30				~1 5
Ca_2	>0 18				?
Zn_2	0 29	<1 7	~0 7		<~1 2
Cd_2	0 24	<1 4 >0 9	~0 7		?
Hg_2	$\geq$0 07	<2 8	<1 6 >1 1	~0 2	<1 5

In the case of quasi molecules, the continuous spectrum accompanying forbidden lines $1\,^1S_0 - 2\,^3P_0$ and $1\,^1S_0 - 2\,^3P_2$ is lacking or very weak, while that with the line $1\,^1S_0 - 2\,^3P_1$ is excited, and the greater the intensity the greater is the triplet separation in the atomic spectrum The continuous band due to the transition $1\,^1S_0 - 2\,^1P_1$ is emitted intensely in the case of all the metals From these results, it seems that the intensity rule for the atomic line holds good in the case of the continuous spectrum emitted by quasi molecules, but similar reasoning does not hold good for the stable molecules

Symmetrical and asymmetrical 'bands' accompanying the lines in the spectrum of thallium are probably due to thallium molecules, but nothing could be deduced as to whether the molecule is diatomic or not At any rate, the structure of the band systems at 3776 A and 5350 A differs from that of the diatomic one The continuous branch extending on the shorter wave length side from edges at 3770 7 A or 2766 3 A in the 3776 A band or 2768 A band may be explained as the excess of energy due to the kinetic energies of the colliding atoms

A detailed statement of the investigation will be published elsewhere

H HAMADA

Physical Laboratory,
Sendai, Japan,
Feb 17

Relation between Electrical Resistance and Energy of Magnetisation

IN a recent paper,[1] Gerlach and Schneiderhan have described some experiments on the electrical resistance of nickel as a function of the temperature and as a function of a longitudinal external magnetic field They have shown that in the absence of an external magnetic field there is, in addition to the normal linear change of resistance with temperature, a term which is directly proportional to the energy of spontaneous magnetisation The accuracy with which this relation holds good for all temperatures up to the Curie point is very striking

Gerlach and Schneiderhan have also examined the change of resistance as a function of an external longitudinal field at constant temperature, for a range of temperature around the Curie point The change is shown to be a maximum at the Curie point and to fall off quite rapidly both above and below this temperature Considered as a function of temperature, the change of resistance in a given field varies in a manner strikingly like the variation of the magneto-caloric effect with temperature[2] One is therefore again led to consider this change of resistance as being

a result of the change of magnetic energy which occurs on application of an external magnetic field, since the magneto caloric effect is a direct measure of this energy change There is, however, one difficulty in interpreting these results According to Gerlach and Schneiderhan, the resistance in the neighbourhood of the Curie point varies linearly with the field This result seems to be in contradiction to the rest of the paper for the magnetic energy cannot vary linearly with the field over any protracted temperature range, in fact, in the quasi paramagnetic state above the Curie point, the energy must be proportional to the square of the field In the neighbourhood of the Curie point, the energy may be a complicated function of the 'external' field depending upon the exact relation between the intensity of magnetisation and the field

I have examined the change of resistance near the Curie point for fields up to 7000 gauss, as against the 400 gauss maximum of Gerlach and Schneiderhan Just below the Curie point the resistance is found to vary almost linearly with the applied field, at the Curie point it varies more slowly than the first power of the field, and then with rising temperature the relation changes progressively to a linear relation between the resistance and the square of the applied field This is exactly the course followed by the magneto caloric effect and is therefore in striking agreement with Gerlach's suggestion that the resistance changes linearly with the magnetic energy The transverse effect has also been examined and although differing greatly from the longitudinal effect at room temperatures, it gives identical results both near and above the Curie point This would, of course, be expected if we are concerned only with an energy change

The results of the present work therefore, although differing in one respect from the results of Gerlach and Schneiderhan, confirm the main suggestion made by them concerning the intimate relation between electrical resistance and magnetic energy A more detailed account of the work will be published elsewhere

H H POTTER

H H Wills Physical Laboratory,
University of Bristol,
Mar 12

[1] *Ann d Phys* **5** 6 p 772
[2] Weiss and Forrer *Annales de Phys*, **10**, 5, p 153

Effect of Internal Stress on the Magnetic Susceptibility of Metals

IN a very interesting communication in NATURE of Dec 27, 1930, p 990, K Honda and Y Shimizu show that by high pressure the susceptibility of copper is changed * from paramagnetic to diamagnetic The following is a simple explanation of this fact, without any special theory concerning the susceptibility of metals We assume that the high pressure, giving a diminution of density of 0 5 per cent, so far destroys the crystal lattice of the copper that parts of the metal become amorphous, then the susceptibility after the deformation may be considered as due to the diamagnetic portion of the normal lattice together with the paramagnetic parts of the amorphous metal, the latter enclosed as a gas in the crystalline copper It is easy to calculate that, 0 5 per cent of the metal being amorphous, the susceptibility will be changed by the amount given in the communication by Honda and Shimizu At the temperature of re crystallisation, the amorphous parts will disappear and the metal will regain its normal susceptibility—just as observed in the experiments quoted

W GERLACH

Munich, Feb 27

* Change of diamagnetic susceptibility with stress was found first by H J Seeman and E Vogt, *Ann d Phys*, **2**, p 980, 1929

Scattering of X-Rays by Mercury Vapour

IN a previous note [1] a calculation has been made of the intensity of total scattering of X-rays by monatomic gases according to a formula deduced by A H Compton [2] and C V Raman,[3] and fair agreement is obtained with the experiments of Barrett [4] on the scattering of X rays by helium and argon gases

By a photographic method, Scherer and Staeger [5] have recently studied the total scattering of copper $K\alpha$ radiation by mercury vapour for scattering angles ranging from 20° to 160° It is certainly of interest to compare our theory with these results In particular, as mentioned by Waller and Hartree,[6] there are

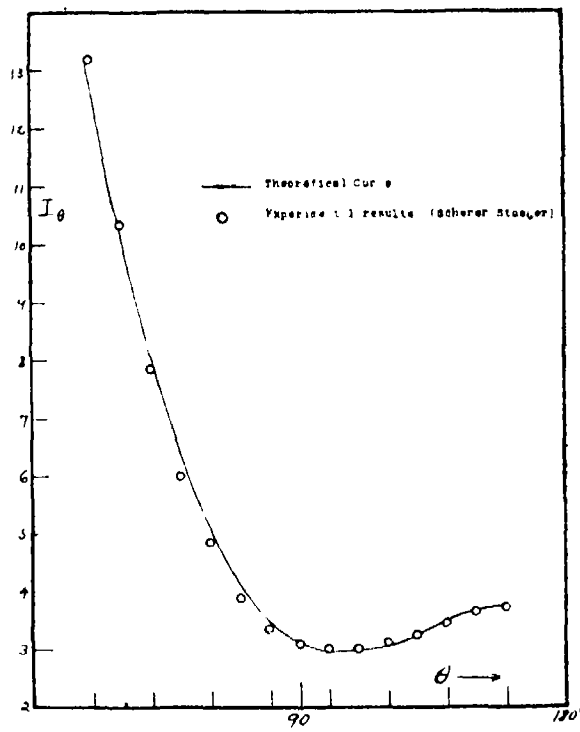

FIG 1

difficulties in applying the wave mechanical theory of X ray scattering recently developed by these authors to the scattering by a heavy atom like mercury, we would like to see how our theory could account for the experiment in this case Such a comparison is made in Fig 1 The full curve represents the theoretical values of the scattering per atom in arbitrary units, plotted against the scattering angle θ The encircled points are the experimental data taken from the scattering curve given by Scherer and Staeger and fitted to the theoretical curve at θ equal to 90° It is seen that the agreement between theory and experiment is satisfactory throughout the range of the scattering angle examined

It may be pointed out that for the scattering of copper $K\alpha$ by mercury vapour, the contribution from the incoherent scattering to the intensity of total scattering amounts to about one per cent Thus the scattering nearly follows the well known expression

$$I_\theta = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2C^4}F^2,$$

where F is the 'atomic structure factor' (that is, equivalent to ZF of the previous note, loc cit) The

F curve was calculated from the atomic field of Thomas and Fermi as previously employed

Y. H. WOO

Department of Physics,
National Tsing Hua University,
Peiping, China,
Feb. 17.

[1] NATURE, Oct. 4, 1930; *Proc. Nat. Acad. Sci.*, **16**, 814; 1930.
[2] *Phys. Rev.*, **35**, 926; 1930.
[3] *Indian J. Phys.*, **3**, 357; 1928.
[4] *Phys. Rev.*, **32**, 22; 1928.
[5] *Helv. Phys. Acta*, **1**, 518; 1928; cf. also Kirchner, Allgemeine Physik der Röntgenstrahlen, p. 496.
[6] *Proc. Roy. Soc.*, A, **124**, 121; 1929.

Band Spectrum of Bismuth Hydride

A BISMUTH arc, operating in a hydrogen atmosphere at reduced pressure (10–20 mm.), emits the line λ4722 of bismuth (Bi) with great brilliance. A faint band spectrum was found to occupy the vicinity of this line. However, using a quartz discharge vessel, fed with 0.5 amp., 1200 v. d.c., and the bismuth vapour distilling at 900° C. through a narrow end on tube, this band spectrum comes out with great intensity, and so we succeeded in photographing the bands at large dispersion.

The bands are composed of single P and R branches, having their lines well resolved, and consequently we assign the system to a $^1\Sigma - {}^1\Sigma$ transition in the bismuth hydride (BiH) molecule. From an analysis of the bands (0, 0), (1, 1), and (1, 0) the following constants were calculated:

$$\nu_0 = 21278.3 \text{ cm.}^{-1},$$

$$\begin{array}{ll} B_0' = 5.216 \text{ cm.}^{-1}, & B_0'' = 5.066 \text{ cm.}^{-1}, \\ \alpha' = 0.19 \text{ cm.}^{-1}, & \alpha'' = 0.16 \text{ cm.}^{-1}, \\ D_0' = -20.25 \times 10^{-5} \text{ cm.}^{-1}, & D_0'' = -18.5 \times 10^{-5} \text{ cm.}^{-1}, \\ r_0' = 1.791 \times 10^{-8} \text{ cm.}, & r_0'' = 1.818 \times 10^{-8} \text{ cm.}, \\ \omega_0' \sim 1674 \text{ cm.}^{-1}, & \omega_0'' \sim 1677 \text{ cm.}^{-1}, \\ \omega_0'x' \sim 15.5 \text{ cm.}^{-1}, & \omega_0''x'' \sim 21 \text{ cm.}^{-1} \end{array}$$

The vibrational frequencies ω_0' and ω_0'' were derived from the relation $D_0 = 4B_0^3/\omega_0^2$. Up to the very last lines observed ($K = 32$) the rotational structure of the (0, 0) band is well checked by the ordinary formula $F(K) = BK(K+1) + DK^2(K+1)^2$ if we add a small uncoupling term ϵK in the final term ($\epsilon = -0.042$).

The near coincidence of ν_0 with the atomic line λ4722 and the close agreement between the constants of the initial and the final terms of the band system, make us inclined to suggest that the electronic states of the molecule originate from the corresponding states $2s$ and $^2D_{3/2}$ in bismuth, the hydrogen atom remaining unexcited. Our suggestion also harmonises with the appearance of a small, negative l-uncoupling term in the final state of the molecule. Such uncoupling terms are, according to the theory,[1] to be expected in molecular terms derived from atomic P, D terms. It is further of some interest to note that while the triplet band systems known in the spectra of NH and PH are derived from deep lying quartet terms in N and P, the singlet system of bismuth hydride probably originates from the doublet system in bismuth.

A full report of the spectrum will appear later in connexion with the analysis of other band systems of bismuth hydride situated in the red part of the spectrum.

A. HEIMER.
E. HULTHÉN.

Laboratory of Physics,
University of Stockholm,
Mar. 9.

[1] See esp. W. Weizel, *Phys. Zeits.*, **31**, 880; 1930.

The Values of e, h, e/m, and M_P/m

IN a recent paper,[1] I showed that the six methods usually used for deducing the value of Planck's constant, h, could be used collectively to evaluate both e and h, without assuming any direct determination of e (such as that of Millikan). This seems to be the most accurate way of estimating e and h that is so far available.

I have now repeated the calculations, using all the data referred to by Birge as suitable for estimating h,[2] as well as all the estimates of e/m given by Birge and in the "Handbuch der Physik" of Geiger and Scheel (vol. 22, p. 81). From the values of e and h thus deduced I find

$$hc/2\pi e^2 = 137.01_7 \pm 0.05_9.$$

This is in such good agreement with Eddington's theoretical prediction of exactly 137, that his equation is slightly more firmly established than any of the other equations relating e and h.

By assuming Eddington's equation, the values of e and h can be deduced somewhat more accurately. I give for comparison Birge's estimates:

	Birge	Bond	Difference	Sum of probable Errors
$e \times 10^{10}$	4.770 ± 0.005	$4.779_4 \pm 0.001_1$	0.000_4	0.006_1
$h \times 10^{27}$	6.547 ± 0.008	$6.558_4 \pm 0.003_1$	0.011_4	0.011_1
$(e/m) \times 10^{-7}$	$\begin{Bmatrix} 1.761 \pm 0.001 \\ 1.769 \pm 0.002 \end{Bmatrix}$	$1.769_0 \pm 0.0004_4$		
M_P/m	$\begin{Bmatrix} 1838.20 \pm 1 \\ 1846.61 \pm 2 \end{Bmatrix}$	$1846.6_7 \pm 0.4_4$		

My probable errors should be accurate to about 10 per cent, as the calculations depend on 36 sensibly independent data.

The difference between my estimate of M_P/m and Eddington's theoretical suggestion of $(136)^2/10 = 1849.6$, is 3.0_3, or 6.3 times as large as my probable error. I can only conclude that this is very strong evidence against the value of M_P/m being exactly $(136)^2/10$.

I write this in memory of J. R. B.

W. N. BOND.

Department of Physics,
University of Reading,
Mar. 14.

[1] *Phil. Mag.*, December 1930.
[2] *Phys. Rev. Suppl.*, vol. 1, No. 1, pp. 48-57.

A New Band System of Copper Hydride

A BAND system consisting of six band heads has been found in the region λλ2900–2200. It is different in nature from the two systems previously known for the molecule. The bands are double headed, indicating that their emitter consists of an odd number of electrons, and thus they have been attributed to the ionised copper hydride (CuH^+) molecule. The band structure has been analysed. It consists of nine branches, namely, six main branches and three satellites, and the branch lines obey the K selection rule. From the intensity relations of the branch lines for low quantum values, it is found that $Q > R > P$. Thus the system has been assigned a $^2\Pi \rightarrow {}^2\Sigma$ transition. The $^2\Pi$ level is inverted. From the vibrational quantum analysis, $\omega_0'' = 1874$ cm.$^{-1}$. This is in good agreement with the value as calculated from the relation given by Kratzer, namely, $\omega_0^2 = -4B_0^3/D_0$. The values of B_0'' and D_0'' are 3.30 cm.$^{-1}$ and -4.16×10^{-5} respectively.

P. C. MAHANTI.

Applied Physics Laboratory,
Calcutta University,
Feb. 19.

Polarisation of the Raman Spectrum of Water

The Raman spectrum of water has been studied in great detail by a large number of workers, notably A S Ganesan and S Venkateswaran and A L Meyer So far as I am aware, however, no attempt seems to have been made to study the polarisation of the Raman bands I have studied the Raman spectrum of pure water by the original method of Raman The liquid, which was enclosed in a large bulb, had been carefully purified by repeated distillation *in vacuo* The polarisation photographs of the liquid were taken with a fairly wide slit, due corrections in the exposures for the two directions of the nicol, for the polarisation introduced by the optical train in the glass spectrograph itself, having been made by a previous calibration of the instrument

The intensities of the bands were estimated by a plate containing a series of graded exposures of the mercury spectrum The following table indicates the results obtained

Wave number shift (mean) excited by 4358 3 A	Depolarisation factor	Intensity
3100	0 60	Medium
3400	0 48	Strong
3600	0·75	Weak

From these observations I conclude that

(1) The three different Raman bands excited by the same incident lines are differently polarised

(2) The degree of polarisation of the different Raman bands (excited by the same line) seems to increase as the intensity of the band increases

The 3 13μ band has been attributed to a polymer of H_2O But whether the variation of the depolarisation factor is to be attributed to the variation in the geometric character of the oscillations involved, or has a definite bearing on the relative intensities of the bands themselves, is more than we can say at present C Ramaswamy

Physics Department,
The Presidency College,
Chepauk, Madras

Thermophilic Bacteria in Milk

Mudge and Thorwaldson [1] have advanced a new theory to account for the proliferation of the so called thermophilic bacteria in milk during pasteurisation at 62 8° C The fluctuations in numbers which occur at short intervals during pasteurisation are so sudden and violent as to require some further explanation than is supplied by mere proliferation, even if it is at its optimum They suggest that the organisms exist in milk as dormant spores which, unless the milk is subjected to the action of certain physical and chemical stimuli such as heat, cold, or the action of alkalis, remain ungerminated

Work which is in the process of completion in this laboratory has furnished evidence in support of this suggestion of Mudge and Thorwaldson, although it was arrived at by an entirely different route During the investigation of a spore forming organism isolated from commercial sterilised milk, it has been found that the germination of the spore, and subsequent spore formation, depends upon the effect of heat

If after inoculation into milk the spores are heated, germination invariably occurs If, however, the culture is not heated, germination is very much reduced and fails in the second generation The original spores are gradually lost by a process of dilution during subsequent cultivation and a stable vegetative form of the organism is obtained

If to a culture of heated spores (possessing the power to germinate) a small quantity of a living culture of the vegetative form be added, a number of these spores are so affected that they immediately lose the power of germination, and if they are allowed to remain in contact with the vegetative culture for 24 hours, this power is lost by all If, however, to a culture of a number of spores, isolated by the Barber single cell technique, which cannot be induced to germinate by heating alone, a small quantity of a *killed* culture of the stable vegetative form of the organism be added, germination, followed by normal spore formation, takes place

It appears that the stable vegetative form, which has been found to dissociate from the sporing form, bears an inhibiting factor which is heat labile It therefore seems that the significance of heating lies in the destruction of this factor, and it may be that the dormancy of the spores of thermophilic bacteria in milk, which is destroyed by heating, is due to the presence of a similar inhibitory factor M I Christian

University of Reading,
National Institute for Research
in Dairying,
Shinfield, Nr Reading,
Feb 5

[1] *Milk Dealer*, December 1930 57

Two New Colour-types in Cats

During the past year, we have obtained two cats each of which is apparently a new colour type The first seems to be an albino He was exhibited at a cat show in Paris in 1930 and came into our possession shortly afterwards

Hitherto albinism in cats has been unknown White cats do occur and are sometimes referred to as albinos but their eyes are pigmented—often blue, sometimes yellow or green—and the white coat colour is actually dominant white

The white cat in our possession has eyes very like those of an albino rabbit The iris is translucent white, and when the pupil is dilated the eyes look blood red In appearance the cat is a perfect albino but it is not yet known how his colour is transmitted He appeared in a strain of Siamese, and it is of interest to note that the Siamese coloration is the nearest approach to albinism hitherto found amongst cats Siamese in cats is almost certainly comparable to Himalayan in rabbits, and Himalayan is next to the lowest member of the series of allelomorphs extending from black to albino

The second cat is a self brown, very much the colour of ground coffee He was previously owned by the late Mr H C Brooke and was shown by him at the Crystal Palace as a self red Brown coat colour occurs in many domestic animals, but also has not hitherto been recorded in cats Yellow cats are fairly common They are often referred to as orange, red, or marmalade—actually they are yellow with darker, orange brown markings

The self-brown cat in our possession was evidently considered to be such a 'red' without the lighter patches His colour is, however, entirely different from anything found on a red—it is a true dark brown without markings It is not yet known how his colour is transmitted, and nothing is known of his origin

Ruth C Bamber (Mrs Bisbee)
E Catherine Herdman

Zoology Department,
University of Liverpool,
Mar 13

Research in the Modern State *

There are few documents which present a more comprehensive picture of the manifold ways in which scientific research is applied, not only to industrial problems but also to the service of our daily needs, than the annual reports of the Department of Scientific and Industrial Research All the major needs of the population are touched by the activities of the Department—food and clothing, air and water supply, heating and lighting, communications and transport, housing and building—in each of these spheres science is making important contributions, and promoting not material developments alone but also the solution of many problems which menace the national development and health There is no department of State in which the beneficial influence of the Department of Scientific and Industrial Research is not felt, and it is probable that no proportion of the national income is more profitably spent than the comparatively small sum of £711,200 (gross) or £536,746 (net) which represents the expenditure of this Department for the year ending Mar 31, 1930.

The report of the Department for the period, Aug 1, 1929–July 31, 1930, which has recently been published, includes the short report of the Committee of the Privy Council, signed by Lord Parmoor, with the report of the Advisory Council and summaries of the work carried out by the National Physical Laboratory (representing the largest single item of expenditure, £205,301 gross, or £100,418 net), and the Chemical Research Laboratory, by the twenty research associations which are in receipt of grants, and under the direction of the various research boards Appendices deal with the research boards, committees, and establishments of the department, finance, publications, and developments during the period in the organisation of industrial research in other parts of the British Empire The extent to which scientific knowledge is now woven into the fabric of modern life is well indicated by the list of some forty-five research boards and committees and of the twenty research associations, to the support of which grants amounting to £70,931 were contributed during the year The personnel of these committees comprises many of the most distinguished scientific workers in Great Britain, and much of the voluntary service they thus render receives little public recognition As in the year under report, the results of scientific work are seldom spectacular, and even when a fundamental discovery has been made, years may elapse before it becomes a benefit to mankind The absence of spectacular results from the present report, in fact, renders it a more valuable document from which to assess the immense normal contribution such work makes to our common wants

In the course of a short article it is impossible even to catalogue the wide range of subjects coming within the province of the Department, and a few examples only will be selected to illustrate the intimate relationship of its work and our daily life Even to outline the work of the research associations would carry us beyond our limits, and it must be sufficient to refer to the investigations being carried out by the British Non Ferrous Metals Research Association on the effect of frost on the bursting of water pipes, which is to include pipes made of lead, the new lead alloys, copper and iron so far as they are used in domestic installations, and by the Research Association of British Paint, Colour, and Varnish Manufacturers on the durability of films of paint or varnish, etc The tests carried out have already made it possible to obtain much valuable information regarding the probable performance of paint materials in use The British Cotton Industry Research Association has successfully introduced a new antiseptic, 'Shirlan', to protect cloths exported to warm damp climates, and warps stored under damp conditions at home from the deleterious effects of mildew development The British Launderers' Research Association has studied the laundering of rayon, and directs attention to the caution needed in finishing, for example, ironing, such fabrics, whilst the Wool Industries Research Association has reported the unexpected discovery that when sulphur dioxide and alkali are present in particular proportions they assume a phase of exceptional activity By taking advantage of this active range a new, effective, and cheaper process of bleaching has been developed

The increasing use of electricity for domestic purposes is not unaccompanied by dangers Thus, while the necessity for earthing as a means of avoiding the danger of shock or mitigating its effect is generally acknowledged, the means for obtaining a 'satisfactory' earth have not been described, and wide variations exist in practice, some of which are hazardous and others unnecessarily expensive This question, and also the elimination of fatigue failure in the overhead lines now widely used for the transmission of power at high voltages, are occupying the attention of the British Electrical and Allied Industries Research Association By work of this kind, the consumer benefits through obtaining a better article, and in some cases also a cheaper article The standard of living is thus being gradually raised as a result of the application of discovery to production Research on the electric lamp, for example, has enabled the consumer to-day to obtain more than four times the light his grandfather could obtain for the same money

The work of the Fuel Research Board is of outstanding importance, whether for industrial or domestic purposes, and on this work a gross sum of £95,305 was expended Some account of the investigations conducted by the Board has recently

* Department of Scientific and Industrial Research Report for the Year 1929–30 (Cmd 3789) Pp 224 (London H M Stationery Office, 1931) 3s 6d net

appeared in NATURE (Mar 7, p 386), and the results of the study of low temperature carbonisation have led to the formation of a Low Temperature Coal Distillers' Association This work is linked up with the investigation of the tar oils produced as by products which is being carried out by the Chemical Research Laboratory, Teddington The main object of the low temperature carbonisation process—the production of a satisfactory smokeless fuel—can only be achieved if the by-products can find a suitable market, and it is accordingly worthy of note that Bakelite ' and ' Novalak ' resins have been successfully prepared from phenolic fractions of this low temperature tar, whilst interesting results have also been obtained at Teddington in cracking, hydrogenation, and syntheses from the same tar

A closely related problem is that of atmospheric pollution, and the investigations of the research committee dealing with this have now reached an advanced stage Improved methods of obtaining information on atmospheric pollution are being elaborated, including methods for the determination of sulphur in the atmosphere, the approximate total sunlight received, and the lateral distribution of atmospheric impurity from a centre of pollution under different weather conditions

The importance of preventing water pollution was particularly demonstrated during the dry summer of 1929, and has stimulated interest in the work of the Water Pollution Research Board A comprehensive scientific survey of the Tees as a typical river flowing through an industrial centre has been undertaken, and already the general changes in the composition of the river water and in the fauna and flora of the river from source to mouth at different times of the year and under different conditions of rainfall and tide, have been ascertained The very serious pollution occasioned by effluent from beet sugar factories has received special attention, and investigations carried out in co operation with the industry have shown that there are practical methods by which such excessive pollution can be avoided Another investigation in which the Chemical Research Laboratory is also participating is concerned with the difficulties caused by the corrosive action on iron mains and the plumbo solvency of certain waters

The work of the Food Investigation Board entailed a gross expenditure of £38,531, or £14,237 net, with a further £9736 on the extension of the Low Temperature Research Station at Cambridge —figures which seem infinitesimal in regard to the importance to the nation of the successful preservation, storage, and transport of fruit, vegetables, meat, and fish The extension at Cambridge will accelerate the work on meat, in which important scientific and practical results have already been achieved in relation to freezing of gelatin gels and to the factors responsible for loss in ' bloom ' or the freshly killed appearance of lamb Work on the scientific basis of the curing of meat is providing a rational explanation of the customs of the curing industry, which are at present empirical and obscure

The characteristic English breakfast has received special attention, for the programme of work has included large scale investigations on the storage of frozen bacon and on the factors involved in control of the cold storage of eggs During the year, construction of the new station at East Malling has advanced sufficiently to permit research on the storage of fruit on a semi commercial scale, and a report has been published which should facilitate the elimination of wastage in fruit transport and storage, and another on the optimum temperatures and atmospheres for use in the gas storage of fruit, which has led to a remarkably successful method in one of the large commercial stores

Research on the preservation of fish by cold, the smoking of fish, and the bacteriology of fish preservation has been commenced at the Surrey research station This work has been supplemented by work carried out at sea in the steam drifter *City of Edinburgh* and by the Forest Products Research Laboratory, which has undertaken an investigation of the chemistry of wood smoke

Much important work carried out by the Forest Products Research Board is concerned not merely with the development of the forestry resources of the Empire, but also with timber preservation and methods of preventing dry rot or attack by the ' death watch ' beetle or other insect pests Such work like that on the seasoning or creosoting of larch poles to prevent the serious wastage by longitudinal splitting is obviously related to the use of timber in building or constructional work, and in this field the Building Research Board is making a steady advance Factors involved in weathering, the composition and properties of cement, the stresses and strength of constructional materials such as concrete, earth pressure, and the fatigue of materials, have received systematic investigation An experimental house has been used to correlate the heat requirements with weather conditions so as to obtain maximum efficiency from the point of view of the user

The work of the Illumination Research Committee is also closely connected with housing problems, as is that of a joint committee of the Fuel and Building Research Boards on Heating and Ventilation The former has directed investigations at the National Physical Laboratory on the effect of window size, colour, and reflection from walls and ceilings on the illumination of rooms, the effect of distribution and colour of various systems of lighting on clerical work, as well as investigations on street lighting and glare

The latter represents only one of the ways in which the work of the Department impinges on the important field of transport The establishment of a locomotive experimental station for tests and general research on locomotives, the testing of ship forms and propellers carried out in the William Froude National Tank, and the establishment of a second tank for research on ship design, resistance, and propulsion, etc , the aerodynamics research at the National Physical Laboratory, and the investigation of the Fuel Research Board on the

causes of fires on steamships in bunkers and cargo coal, are sufficient evidence of the important contributions made in every field of transport, without enumerating the metallurgical research or the important engineering investigations carried out at the National Physical Laboratory

In another field of communications, the Radio Research Board is making contributions which affect the millions of homes where broadcasting is received, while dental research, the production of insecticides for the destruction of the cocoa moth, the production of new drugs, and the discovery of the efficiency of borax—boric acid mixtures for the fireproofing of fabrics—and investigations on the action of sunlight on cotton, which have revealed the deleterious effect of small traces of iron, are all that can be mentioned of the activities of the Fabrics Research Board

Similar work is being carried out in Canada, Australia, New Zealand, South Africa, and in certain fields, notably in that of the transport of fruit and on the investigation of Empire timbers, much has already been done to secure co operation between the mother country and the Dominions overseas Even the above brief survey should make it sufficiently clear that the work of the Department of Scientific and Industrial Research is a vital factor in the prosperity of the British Empire, and upon its wise direction and active prosecution depend in large measure our prospects of restoring our industries to full vigour, exploiting to the full such natural advantages as we possess, and, by increased efficiency where we now possess no such advantages, recovering something of the position we formerly held amongst the industrial nations of the world

Physical and Mental Development of Children

IN spite of the assiduity with which the growing child has been studied within recent years, it cannot be said that we know very much about him But what we do know, and know with any degree of scientific certainty, is set forth in the Report of the Consultative Committee on the Primary School* recently issued The Committee, indeed, has spared no pains in securing the most trustworthy information at present available It has interviewed eighty nine witnesses, it has read a staggering number of memoranda it has examined with special care all evidence which can claim scientific validity Hence it has treated with special respect the opinions of physiologists and psychologists Indeed, much of what is said in the body of the Report about the development of the child is based on two memoranda which are printed in full in the appendix The first is by Prof H A Harris on the physical development of the child, and the second by Prof Cyril Burt on the mental development of the child

Prof Burt's memorandum will be dealt with first It may be said at once that it is wholly admirable It sets forth with great clearness, and with no small measure of charm, all that is certainly known about the psychology of the child of primary school age—all that would receive the unqualified support of the author's fellow psychologists in Europe and America It indicates the views that have survived, and these views show how far we have moved within the last thirty years

Thirty years ago, the orthodox creed was largely based on biology The belief of what happened in the mind was mixed up with a belief of what happened in the body and in its remote progenitors It was believed that in the growing child certain instincts and interests and powers remained virtually dormant up to a given age, and then suddenly woke up and became insistently active Their maturation was almost as sudden as their birth Thus definite layers of mental life were laid down and consolidated, and, on top of these, new layers were superimposed First came the mastery of the physical senses, then the control of the muscular system (including the muscles of speech) which give rise to walking, dancing, talking, and constructing things with the fingers Then came the development of memory, and finally the emergence of a capacity to reason

Mixed up with this stratification theory, as Prof Burt calls it, is the recapitulation theory, which states that the development of the child tends to reproduce in rapid and abbreviated form the evolution of the race He goes through the cave dwelling period, the savage period, and the barbarian period He is at various times in the hunting stage, the nomadic stage, the agricultural stage, the craft stage, and what not

We no longer hold these views—not in their original form at any rate The stratification theory is discredited by the fact that experiment has exploded the old doctrine of distinct faculties, such as memory and reason, and the recapitulation theory is discredited by the failure to find evidence for the transmission of personally acquired characters There is no more reason to think that the son of a potter inherits the aptitudes and interests of a potter (apart, that is, from the influences of his immediate environment) than there is for believing that the son of a mathematician will know the differential calculus by the light of Nature Indeed, these old beliefs have been shattered through their failure to fit in with the facts of the mental life which have been disclosed by direct observation and experiment For the method of direct study is essentially the modern method

This is an important point of methodology The child's mind is studied, not by studying his body, his brain, or his pedigree, but by the simple and obvious method of studying the thing itself The facts to be observed and explained are mental facts Real progress in the study of mental development may be said to have begun when the psychologist resolutely turned a blind eye to the alluring theories of the physiologist or the

* 'The Primary School' (London H M Stationery Office, 1931) 2s 6d net

anthropologist, and began to study the mind as a mind. It was Binet who set the investigator on the right track. His instrument of research was neither a scalpel nor a microscope, but a mental test—a simple examination question, so devised, so applied, and so interpreted, as to become at once a means of discovery and a means of measurement. Indeed, all we know with certainty about the mode and rate of development of the child mind is a result of the direct method of mental testing.

This is abundantly evident from Prof. Burt's memorandum. He shows how, by the modern method, it is demonstrated that general intelligence grows with age, that the so-called faculties are all mixed up together from the very start, and that special intellectual interests and abilities develop, though they do not begin, at successive ages of school life. The new findings wholly fail to confirm the old theories. There is no ground for the old belief that memory is stronger at the junior school period than at any other; nor yet for the old belief that children cannot reason until they reach the adolescent stage. Children of all ages are found to reason well enough within the range of their understanding.

Prof. Harris's memorandum is equally good of its kind; but is different in kind. It has more of personal theory and conjecture; it pushes out further into the realm of the unexplored. For this very reason, some of his views, interesting and suggestive as they are, must be accepted with caution. He lays much stress upon successive periods of springing up and of filling out that occur in the course of a child's growth. The child mainly grows in height at one period and mainly grows in weight at another. There are, according to Dr. Harris, three of each period. The second springing up period, for example, takes place during the ages of five, six, and seven years; and the second filling-out period during the ages of eight, nine, and ten. The curves of growth, however (one for height and one for weight), which he publishes in his memorandum, afford but slight evidence of these periods. Indeed, he admits that his inferences are drawn from clinical observations rather than from the curves of growth.

The existence of this rhythm is not denied; nor is the importance that Prof. Harris attaches to a recognition of this rhythm; but what is in doubt is whether it follows such simple laws as his classification suggests. A letter is at hand from a schoolmaster in Lancashire, who for many years made careful and regular measurements of his daughter's increase in height. For many years, beginning at the age of three, she grew at the rate of two inches a year—one inch in April and another inch in October—her stature being practically constant for the remaining months of the year. During the two growing months, she was mentally inert; and during the two months that respectively followed she often succumbed to the various illnesses incident to childhood. This, of course, is only one case; but other similar ones might be mentioned, which at least indicate that the rhythm is to a large extent individual and personal. If there is a wide wave of tendency over a long period, there are many ripples on the wave.

Prof. Harris shows clearly that sex differences appear all along the line, and not merely at adolescence. Indeed, it has long been an accepted fact that in the matter of physiological age, as judged by the eruption of teeth, the ossification of the wrist bones, and the onset of puberty, there is a difference between the two sexes which at the age of eleven amounts to about two years. Anatomically, a girl of eleven is at the same stage as a boy of thirteen. Here we find a clash of opinion between the physiologist and the psychologist. While the physiologist proclaims a wide disparity between the development of boys and the development of girls, the psychologist just as confidently proclaims their identity. He tells us that neither in the level nor in the rate of intellectual development is there any appreciable difference between boys and girls. There are emotional differences, and differences of interest; but no difference in general intellectual power. The truth, of course, is that each class of statements is valid in its own sphere. As boys and girls differ in muscular development, they should play apart; as they roughly agree in intellectual development, they may study together.

Each class of statement is valid in its own sphere; and Prof. Harris's valuable memorandum will be read with much interest and profit by all concerned with the nurture of the young. It is illustrated by excellent photographs; it is enlivened by wise and epigrammatic sayings; it is abundantly provocative of thought. It is only when he leaves his own territory and would base psychology on physiological facts that we join issue with him. He says, for example: "All growth and proliferation on the one hand and all differentiation for special function on the other will probably be found to be the ultimate basis of a rational psychology, whether it be labelled 'Gestalt' or not." As a pious belief we may let it remain. As a guide to psychological research, it seems to anyone who is familiar with the false clues of the past to stand on the same level of usefulness as the project of the Laputan philosopher to extract sunshine out of cucumbers.

P. B. Ballard.

Obituary

Dr. Enrico Sereni

The sudden death of Enrico Sereni, at Naples on Mar. 1, ends prematurely, at the age of thirty years, a career full of scientific usefulness and promise. Sereni had been in charge since 1926 of the section of physiology at the Zoological Station at Naples, and so was well known to the many biologists who worked there. To his British physiological friends and colleagues he was better known from having spent a large part of 1924 in London at University College, and from having travelled with them to and from the International Congress

of Physiology in Boston in 1929 He valued his connexion with Great Britain, and his friends will miss his frequent and cheerful greetings

Sereni took the degree of M D in 1922 with honours While still a student he had been awarded three scholarships for research work which he performed in the laboratory of human physiology in Rome After graduation, he obtained, in competition, a studentship from the Ministry of Education to work in Italy and abroad This was how he came to London, though he supported himself here, frugally enough, for a longer period than the studentship allowed, by working early and late, assisting a medical friend, so leaving the days free for the laboratory In 1923, he was appointed assistant in the Department of General Physiology in the University of Rome, and in 1925 *libero docente* From 1925 he gave, every year, in the University of Naples, a course of lectures on physiology for students of medicine and science In 1926 he was appointed to the position which he held when he died Before entering the University, Sereni had volunteered, at the age of seventeen years, for military service, serving as a lieutenant and gaining the Croce di Guerra

Sereni's researches extend over various fields of physiology His most important work deals with anaphylaxis, which he studied from a general biological point of view on men, on various animals, and particularly on tissue cultures He worked more recently on the humoral and nervous coordination in cephalopods and on the behaviour of unstriated muscle A V H

Mr J G Millais

Mr J G Millais, who died on Mar 24, the sixty-sixth anniversary of his birthday, was a man of many interests and talents A traveller and a sportsman, who followed big game on the continent of Europe, in Africa, and in North America, an artist and a naturalist, who could write discursively about the ways of wild life or particularly upon specific themes, he unified all these interests in authorship The variety of subjects of his published works is great, as the standard of his descriptions and accuracy is high, yet devotion to sport lay behind most of his writings

Millais' travel books are always interesting and contain many acute natural history observations His monographs, essential to the British naturalist, show a wonderful range of information "The Natural History of British Surface Feeding Ducks" (1902) was rounded off by two volumes on "British Diving Ducks" (1913), and in the interval he wrote "The Natural History of British Game Birds" (1909) Amongst mammals, he opened with a standard work on "British Deer and their Horns" (1897) and proceeded to the most important of all his books, "The Mammals of Great Britain and Ireland", published between 1904 and 1906 The three enormous volumes of this monograph, awkward to handle because of their bulk and weight, contain the best complete account of their subject we possess Latterly, Millais' interests concentrated upon the flower garden, and amongst his last publications are "Rhododendrons and their Hybrids", a series of three volumes running from 1917 to 1923, and 'Magnolias" (1927)

Millais inherited artistic ability from his father, Sir John Millais, and illustrated in full or contributed to the illustration of his own books, but his finished drawings are inclined to be rather stiff and hard in tone, and lack the freedom of line and spontaneity which characterise the pencil sketches he often reproduced J R

We regret to announce the following deaths

Dr J Anderson, formerly fellow of the London School of Tropical Medicine, later professor of medicine in the University of Hong kong and recently director of the division of medicine in the Henry Lister Institute at Shanghai, aged fifty two years

Prof R K Butchart, professor of mathematics in Raffles College, Singapore, and formerly professor of physics in Wilson College, Bombay, on Mar 30

Prof W C M'Intosh, F R S, emeritus professor of natural history in the University of St Andrews, distinguished by his work in marine biology, especially the systematic study of British marine annelids, on April 1, aged ninety four years

Senator R Nasini, professor of chemistry in the University of Pisa, on Mar 29, aged seventy five years

Prof Hugh Ryan professor of chemistry in the University College of Dublin and Chief State Chemist to the Irish Free State, on Mar 27, aged fifty seven years

News and Views.

The report of the Court of Inquiry into the loss of the airship *R101* over Beauvais on Oct 5, 1930, has just been issued (Cmd 3825 London H M Stationery Office 2s 6d net) It admits that an exact explanation of the immediate happenings leading to the disaster can never be given, owing to the lack of evidence, but by examining various hypotheses the Court has come to the unanimous conclusion that the one presented is the most plausible This is, that there was a rapid loss of gas from one of the main forward gas bags, added to a heaviness from a gradual leakage of gas due to attrition of the bags, probably greater than was suspected A heavy down air-current forced the nose down, and at the same time may have either caused or accelerated an existing tear in the outer envelope The rush of air through this, again, may have either initiated or extended a split in the inner bag It is known that the wind was variable enough to have buffeted the nose of the ship up and down, and the height coxswain, only just on duty and fresh to the 'feel' of the elevators, had possibly over corrected an upward deflection when the downward one caught him He then lost height to a dangerous extent while swinging the elevators to the other extreme position, but eventually succeeded in correcting the ship's altitude The further loss of height following this appears to have been intentional in an endeavour to make a

slow landing when it was realised that a crash was inevitable

THE other part of the report on the loss of *R101* is devoted to discussing the responsibility for the undertaking of the flight to India at that early stage in the ship's development. It is quite clear that although there were an exceptional number of novelties in design, there is no evidence of the failure of any of these having been either the cause of, or even contributory to, the disaster. On the other hand, the programme of flying trials as originally drawn up by the experts at Cardington had been curtailed. Since the addition of the extra bays, the ship had never flown in anything but exceptionally fine weather, and had never carried out speed trials. The airworthiness certificate, without which the flight could not have been undertaken, was apparently issued by the Air Ministry before the report by the Airworthiness of Airships panel upon which it should have been based, was even written. It is abundantly clear that considerations of policy were allowed to overrule all others in deciding that the flight should take place when it did although the blame lies with the system of controlling such work, rather than upon any particular individual.

ON Mar 31 at 11 2 A M (5 2 P M G M T), Managua, the capital of Nicaragua, was almost completely destroyed by a violent earthquake, many of the walls left standing after the shock and the fires that followed being thrown down by strong after shocks on Mar 31 at 9 15 P M and April 1 at 5 15 A M. The principal shock lasted only a few seconds. Estimates of the number of persons killed range from 500 to 2000, out of a population of about 50,000. Though great earthquakes are rather frequent in the Central American republics, it is in Guatemala and Salvador that they are most serious. During the eighteenth and nineteenth centuries, out of 30 very destructive earthquakes, 14 occurred in Salvador, 10 in Guatemala, 4 in Costa Rica, 1 in Honduras, and 1 in Nicaragua. According to Montessus, who has made a detailed study of Central American earthquakes, the most important seismic centres in Nicaragua are those of Leon and Granada, which are respectively 54 miles north and 26 miles south east of Managua. One of the few minor centres in the country lies close to Managua. The most interesting features of the recent earthquake are its brief duration, the comparative smallness of its area of damage, and its occurrence in an almost dormant seismic zone.

A GREAT advance has recently been made in the technique of radio telephony which promises some surprising developments in the near future. The International Telephone and Telegraph Laboratories have shown that it is possible to utilise Hertzian waves, the frequency of which is more than a hundred times greater than the most rapid at present in use. The new method utilises wave lengths of between 10 cm and 100 cm in length instead of the present 'short waves' which lie between 10 metres and 100 metres. The properties of the new 'micro rays' are approximately the same as those of light rays. They can be reflected and refracted by devices of an optical nature and travel in straight lines. The curvature of the earth and the altitude of the sending and receiving stations are the determining factors for the distance of transmission. It is necessary that the two stations should be visible from one another. Hence high sites will be the most desirable in the neighbourhood of populous centres. There appears, however, to be no limit to the number of relay stations that can be used. A demonstration of the new system was given on Mar 31 between officials and engineers on the cliffs at St Margaret's Bay, near Dover, and Blanc Nez, in France. The speech vibrations were applied to a micro radion tube in which oscillations of 1,600,000 kilocycles per second (about 17 cm) were generated. The modulated waves were sent in a straight line by a parabolic reflector 10 feet in diameter to a similar reflector in France, where they were concentrated on the receiver. The demonstration was entirely successful and proved the practical character of the micro ray method. The method provides a wave band nine times the width of that previously available. In addition, as the waves travel in straight lines and their distance range is restricted, a large number of stations can operate on the same wave length and the present congestion of the ether will be relieved.

THE International Telephone and Telegraph Laboratories have also to be congratulated on a notable achievement in the field of facsimile telegraphy. By the new method, pages of type, handwriting line drawings, and plans can be transmitted at the rate of two sheets a minute. In the case of typewritten sheets containing five hundred words, this corresponds to a speed of 60 000 words an hour. In the picture telegraphy at present in use between the Post Office and several continental cities, about twenty minutes is required for the transmission of a single picture. As in the case of other picture telegraphic systems, a device is used in the new method to scan the message in a series of fine parallel lines with a point of intense light. The light reflected from each elementary area of the sheet is collected and led to a photoelectric cell. This cell delivers to an amplifier a signal corresponding in amplitude to the tone value of the picture element, pure white giving a large signal and pure black a zero signal. At the receiving station a similar device is used, the message being replaced by a strip of photographic paper which is moved continuously forward with a speed equal to that of the message at the transmitting end. The beam of light is now obtained by an argon lamp which acts as a light valve. The motors operating the scanning heads are controlled by means of tuning forks. A full description of the method is given in the *Electrician* for April 3. The method is particularly useful for telegraphing languages like Chinese, which have to be rewritten in some alphabetic language before being sent by the Morse code in ordinary telegraphy.

THE Marconi Company has received orders for the erection of a chain of wireless transmitting and receiving stations through the heart of Africa. The stations

have been ordered by the Administrations of Uganda, Kenya Colony, Tanganyika, Northern Rhodesia, Southern Rhodesia, and the Union of South Africa, and they will be used both for the operation of the new Cape to Cairo air route and, in many cases, for general communication. The apparatus to be installed will be for transmission and reception on medium and short wave lengths. When these stations are completed the trans-African aviation service will be the most highly organised long-distance air route in the world, and at the same time internal and external communications will be greatly facilitated throughout the continent. The sites for the stations are to be in the proximity of Kampala (Uganda); Nairobi (Kenya Colony); Moshi, Dodoma, and Mbeya (Tanganyika); Mpika and Broken Hill (Northern Rhodesia); Salisbury and Bulawayo (Southern Rhodesia); Germiston, Victoria West, and Cape Town (Union of South Africa). The wave-lengths used for wireless communication between the aircraft and these stations will be 900 metres, and inter-aerodrome communication will take place on short waves. For general communications, special wave-lengths have been allotted to the stations at Mpika, Broken Hill, Bulawayo, Salisbury, Germiston, and Victoria West, which will be used for this purpose.

IN a dispatch from the Peking correspondent of the *Times* which appeared in the issue of Mar. 30, attention is directed to the manner in which, it is alleged, a Society for the Protection of Ancient Relics, formed some two or three years ago in Peking, is interpreting its functions. The scope of the society is wide, for it covers objects ranging from works of art to fossils. It is semi-official and has the approval of the Nanking Government. Its methods are said to be the subject of much criticism. Apparently the latest object of its attack is Sir Aurel Stein, whose expulsion from Chinese Turkestan, where he is now engaged in exploration, is said to be demanded on the grounds that while he was raising funds in the United States he spoke slightingly of the new China, and that his funds are too large for his purpose, which must have an ulterior and, it is presumed, political object. It will be remembered that Dr. Roy Chapman Andrews experienced obstruction on the return of the Fourth Central Asiatic Expedition from Mongolia, and in the following year the expedition had to be abandoned owing to the delay over the negotiations about the conditions on which the expedition would be allowed to proceed and the Chinese personnel to be attached to it. It is said to have been alleged at the time that Dr. Andrews's expedition was no more than a cover for a search for oil. It is scarcely necessary for us to defend Sir Aurel Stein from these charges, nor the further charge that it was his intention to smuggle out of Chinese Turkestan any antiquities that he might find. The declaration made by him before he entered the country, and forwarded to the authorities by the British Ambassador in Peking, is a sufficient guarantee of good faith, were one needed. Nor is it necessary to enter into the charge against the American expedition, even if there were any evidence before us.

THERE can be no question, however, that the ill-advised publicity given to the character of the material found by the American Central Asiatic Expedition—the dinosaurs' eggs—and the equally injudiciously advertised attempts to raise funds by their sale, aroused the suspicions of the Chinese and impressed upon the less well informed that something of enormous value was being taken out of the country. It was in precisely similar circumstances that the recent legislation relating to antiquities in Egypt was passed. If the Peking Society is animated, not by a hatred of the 'foreign devil', but by a genuine desire to preserve China's antiquities for China, this is a perfectly legitimate aspiration, recognised as the right of nearly every civilised country, even England—or at least it will be in some degree when the new Ancient Monuments legislation is in force. If this desire is not genuine, as the *Times* correspondent suggests, then an attempt should be made to arrange a *modus vivendi*. It is admitted that, in addition to official personages, the society consists largely of the officials of universities, museums, libraries, research institutes, and the like. A great deal of archæological work has already been carried out in China by Europeans, and we have it on the authority of Prof. Elliot Smith in regard to the latest and greatest discovery of all, the Peking skull, that individual Chinese drawn from the classes which compose the society have co-operated wholeheartedly in organising the work of the geological survey which led up to the discovery of the skull, in the actual discovery, and in the work of preparation in the laboratory with Dr. Andersson, Dr. Davidson Black, Prof. Elliot Smith himself, and others of non-Chinese nationality, who have assisted them from time to time.

MR. BERTRAM THOMAS has been awarded the Founder's Medal of the Royal Geographical Society and also the Burton Memorial Medal of the Royal Asiatic Society, in recognition of his work of exploration in the Great Sandy Desert of Arabia. It is also announced that Mr. Thomas has accepted the invitation to deliver the triennial Burton Memorial Lecture before the Royal Asiatic Society on his return to England. At the close of the War, Mr. Thomas was a political officer in Mesopotamia, and his knowledge of the country and his understanding of tribal Arab character proved of signal service to the administration under Sir Arnold Wilson in the troubled years which followed. After serving in the same capacity in Transjordania, he was selected to be the Financial Adviser and Vizier of the Sultan of Muscat and Oman, being the first Englishman to hold such an office, virtually that of Prime Minister. Both in the course of his official duties and in his leisure, Mr. Thomas has explored some thousand miles of the Oman coast in his patrol boat, while his relations with the turbulent tribes of the littoral have enabled him to penetrate country unknown to Europeans, adding considerably to our geographical, ethnological, and linguistic knowledge of Arabia. An account of his last journey appeared in the *Times* only a week or two ago. His first two journeys in Arabia, of which the scientific results were published in the *Geographical Journal*, the *Journal of the*

Royal Anthropological Institute, and other periodicals, have been pronounced by competent authority to be the most important and extensive piece of geographical exploration carried out since the War

The various organisations connected with research in the textile industries have now reached the stage where much of their work is suitable for direct application to the immediate problems of the industry itself The recent Report of the Council of the Wool Industries Research Association (formerly known as the British Research Association for the Woollen and Worsted Industries) gives a concise summary of the application of the work of that Association to woollen and worsted spinning and to dyeing and finishing processes The Association has, during the past year, continued fundamental research on biological, chemical, and physical problems It has also devoted much time to the examination of the inherent characteristics of the wool fibre, its response to processing, and the possibilities of its utilisation in directions which are as yet undeveloped The report records that in the course of electrical investigations, methods have been devised for the prevention of electrification during the processing of wool, and that the use of wool as an electrical insulator has now become an accomplished fact It further adds that not inconsiderable quantities of worsted yarn have recently left Bradford to be employed for electrical insulation purposes in cable manufacture There is much scope for this research association, and if its new method of financial support by means of a voluntary levy on the industry becomes really successful, its utility to the wool textile industry should be considerably enhanced

The *Journal* of the National Institute of Industrial Psychology, Vol 5, No 5, contains an account of "The Organisation of Works Transport", an investigation carried out by Messrs L I Hunt, W H O'N Manning, and G H Miles The problem confronting the investigators was one of hand trucking in a machine producing works housed in an antiquated building The whole transport system was carefully studied The fluctuating demands of 38 departments and the irregular flow of production along 231 connecting routes were considered Sources of delay were noted, and a comprehensive scheme of reorganisation initiated, this comprised the classifying of routes and their co-ordination under a central transport office A system of circuits, combining all routes, except those with the heaviest loads, enabled a scheduled service to the departments to be maintained Very definite results followed the introduction of the scheme The economy of labour amounted to 60 per cent, one man handling 50 instead of 20 loads, labour costs were reduced by 40 per cent, yet labourers' earnings rose, and an efficient, flexible transport system replaced the old cumbersome one This experiment has been industrially successful, but its scientific value is considerably reduced by the number of variables that have been introduced The arrangement for a bonus payable on individual output and working time follows on in the Taylor Gilbreth tradition and perpetuates the same fallacy In spite of this, however, many interesting points emerge, and Mr Hunt's exposition is admirably concise and lucid

Mr S Morris Bower, of Langley Terrace, Oakes, Huddersfield, is asking for help in extending a statistical inquiry into the frequency of thunderstorms in the British Isles in winter, which was originated by Mr C J P Cave in 1916 and was concluded in March 1929, to a similar inquiry for the six months April to September What is required is a note of the place, date, and time of occurrence of thunder, lightning, or hail, with the direction in which the lightning was seen Additional details, such as the time of commencement of very heavy rain or hail, should such occur, and of the direction of movement of any well developed storm, would be welcome Thunderstorms sometimes move across the country along a definite 'front' that is to say, if crosses are marked upon a map showing where storms occurred at a particular hour, these form a nearly continuous chain, when similar information is shown for a later hour, a similar chain of crosses is normally shown, but displaced from the position that the first chain occupied Phenomena of this kind are readily studied by professional meteorologists at the Meteorological Office with the aid of synoptic weather charts But it is only on a small number of days in the year that anything of this kind is to be found on the synoptic charts Numerous storms, more or less isolated, often occur both in winter and summer They may travel or remain nearly stationary throughout their life history, in the latter case especially they often lie too far from any official reporting station for their occurrence to be noted officially It is especially in regard to this class of storm that an organised inquiry is of value, and until such an inquiry has provided a reasonably complete statement of the facts, there is little prospect of being able to give a satisfactory general account of the thunderstorms of the British Isles

The arrangements for the British Chemical Plant Exhibition to be held on July 13–18 at the Central Hall, Westminster, in conjunction with the jubilee celebrations of the Society of Chemical Industry, regarding which a preliminary announcement was made in Nature of Jan 17, are making rapid progress About forty firms have already booked space, and since these include most of the important firms in the British chemical plant industry, the success of the exhibition is assured The exhibits will cover the whole range of the industry The arrangements which the Chemical Engineering Group of the Society of Chemical Industry is making for the Section showing, on a co-operative basis, the work of the various research associations and of the Department of Scientific and Industrial Research are also well advanced The scheme is being supported by the Department, which will be represented by the National Physical Laboratory, the Chemical Research Laboratory, the Fuel Research Board, the Forest Products Research Laboratory, and the Building Research Board The research associations dealing with the following industries will co-operate boots, shoes, and allied trades, cast iron,

leather, linen, non ferrous metals, paint, colour, and varnish, rubber, wool There will be three main groups, dealing respectively with (1) materials used in chemical engineering, such as metals, fabrics, etc, (2) chemical plant and associated equipment, including that employed on fuel, and (3) testing apparatus and standardisation

So long as mountain peaks remain unscaled by man there will be found hardy adventurers to attempt them, for the glory of achievement as well as for the valuable scientific data which well organised expeditions afford In 1924 there was the last Everest expedition, which ended so tragically with the death of Mr G L Mallory and Mr A C Irvine Last year saw the attempt on Kanchenjunga led by Dr Dyhrenfurth, when the climbers reached Jonsong Peak (24,344 ft) Now we have a British expedition, consisting of Mr F S Smythe (leader), Capt E St J Birnie, Dr R Greene, Mr R L Holdsworth, and Mr E E Shipton, which will attempt Mount Kamet (25,447 ft) According to the *Times* of April 4, the party left Venice on that day for India Mount Kamet is in the Gharwal District of the United Provinces and is in the Zaskar Range, a northern branch from the main Himalayan chain The approach to Mount Kamet will take the expedition across the watershed separating the principal sources of the Ganges, to the glaciers above Gangotri, which is to the east of the main peak, and it is expected to obtain valuable topographical, physiological, botanical, and other data and useful climbing experience There have been several attempts on Mount Kamet in the past, the last being in 1920, so the present expedition should have the advantage of knowledge of local conditions

THE great heights of many of the blocks of buildings recently erected in America and picturesquely called skyscrapers has led to the development of high speed lifts In the *Westinghouse International* for the first quarter of 1931, a description of Carew's Tower, Cincinnati's largest structure, is given It combines a 48 story office building, a 28 story hotel, a 25 story garage, and many retail shops Three floors in the office building are reserved exclusively for doctors and dentists Forty one lifts are required, including six of the fastest in the world, to make life in this self contained city possible The express lifts move at a speed of 900 feet per minute, which is a little greater than ten miles per hour The speed of the local lifts is 700 feet per minute The hotel contains a thousand rooms and is served by nine lifts, six passenger and three service There are three large motor-car lifts serving the parking garage Their speed is altered by varying the applied voltage, thus eliminating mechanical gear They can make a flight up the 25 floors in about half a minute The stores use lifts moving at 450 feet per minute At still slower speeds, dumbwaiters, sidewalk lifts, a 12 5 ton hydraulic lift, and an observatory tower lift operate At speeds of 500 feet and above it is practically impossible to read the numbers on the various floors Lifts for speeds up to 1200 feet per minute are being designed, and at present there seems nothing to stop still higher buildings and still faster lifts from being constructed A description of the lifts used to carry the students from one lecture room to another in the University of Pittsburgh, which is 40 stories high, is also given

SEVERAL special problems have arisen in connexion with the supply of direct current to traction systems Two solutions are in use and they are advancing in widely diverging directions In America, the method of converting alternating current into direct current in the automatic substations is to use machinery of the rotating converter type In Europe the use of mercury arc rectifiers is rapidly extending In a paper read to the Institution of Electrical Engineers on Mar 12, by J W Rissik and H Rissik, the special requirements of traction operation were outlined and the present state of development of the ironclad rectifier for traction use, as reflected in its applications in converting substations on the Continent, was described Since the War, the use of rectifiers in Germany has extended very rapidly The whole of the Berlin city and suburban railway system is supplied by rectifiers in 47 substations, 31 being controlled from a distance The German federal railways have adopted the rectifier as the standard equipment for traction substations The development of rectifiers in America has been comparatively slow, the rectifiers manufactured there are generally designed in accordance with the latest European practice In Great Britain the increased demand has stimulated manufacturers to compete with foreign firms by improving their designs The authors believe that in the scheme of general railway electrification which will eventually be carried out in Great Britain, rectifiers will be used, if not exclusively, then very largely They think that in the next decade Great Britain will be placed in a position comparable with that which now obtains in Germany

WRITING on "Chemistry as a Career", in the *Alumnus Chronicle* of the University of St Andrews, Prof John Read remarks on the current tendency in certain secondary or public schools to carry specialisation too far with apt pupils This tendency appears to be largely a response to the requirements of some of the universities in their entrance scholarship examinations Hence many such pupils acquire little or no knowledge of biology, whilst others are deficient in English, modern languages, mathematics, and other fundamental subjects Prof Read wisely advocates that a pupil should be restrained from inordinate specialisation, until he has secured the necessary basis of a well proportioned general education, and he supports the adoption of a broader test of intelligence and merit than that now imposed on scholarship candidates In the same article, Prof Read explains the complex nature of the chemical profession and surveys the prospects which confront entrants He points out that chemistry provides a multitude of diverse professions, rather than a single homogeneous profession, and that in doing so it provides scope for all sorts and conditions of chemists Just as it is difficult to legislate effectively for the com-

plex racial association of the British Empire, so the complex corporation of chemists is unable to safeguard the interests of the profession in a generally acceptable manner Whilst specialisation at an early stage is undesirable, it is nevertheless essential later, and it is evident that at present there is no overproduction of chemical specialists of first class ability On the other hand, it is difficult to find openings in chemical industry for men of second class attainments or for women chemists possessing the highest qualifications Prof Read pays a deserved tribute to the late Lord Melchett's policy in advancing the career of industrial science, in a scientifically organised chemical corporation with trained chemists in the highest administrative positions and on the board of control, the chemist is no longer the factory 'maid of all work' Expansion of schools of organic research in the British universities in response to demands formulated under the shelter of the Dyestuffs Act has also opened attractive and useful scientific careers

THE biological interests of the Galapagos Islands are so many that it is strange that no thorough exploration of their inhabitants had been carried out since Charles Darwin made them famous, until the islands were visited by the expedition, planned by L M Loomis, formerly director of the California Academy of Sciences, which remained in the field for more than seventeen months during 1905 6 An account of the work of the expedition, by Joseph R Slevin now appears as one of the *Occasional Papers* of the California Academy of Sciences, under the title "Log of the Schooner *Academy*" It is an interesting story The study of the land tortoises, of which 266 specimens were collected showed that, contrary to belief, they still inhabited all the islands in the archipelago from which they were formerly known (except Charles Island), and that they even existed on islands where they were never before observed But many minor biological points attracted the attention of the explorers The tameness of birds and lizards was remarkable both would come to pick up crumbs dropped beside the observer, both, alas! were rewarded by being killed with a switch The lack of sensitiveness possessed by lower animals was well shown when, on a lizard's tail being severed by a knife, the animal did not move until, seeing the wriggling severed portion, it turned about and grabbed it as if it were a foreign object Land iguanas were common on Narborough Island and occurred over the whole area, even to the rim of the crater at an altitude of 5000 feet, and the wild goats on Hood Island, feral descendants of domestic stock, quenched their thirst by drinking sea water on the beach

AT the meeting of the London Mathematical Society on Thursday, May 14, at Burlington House at 5 P M, Prof J E Lennard Jones will deliver a lecture on "Quantum Mechanics of Atoms and Molecules" Members of other scientific societies who may be interested are invited to attend

HIS MAJESTY THE KING has been pleased to approve the award of the Royal Medals of the Royal Geographical Society as follows *Founder's Medal* to Mr. Bertram S Thomas, for his geographical work in Arabia and successful crossing of the Ruba el Khali, *Patron's Medal* to Rear Admiral Richard E Byrd, U S N, for his expedition to the Antarctic, and his flights over both north and south poles

THE first of a series of demonstrations of horticultural machinery is announced in the Mar 26 issue of the Ministry of Agriculture's weekly publications The trials took place recently at Pinhoe, Devon, on a mixed fruit plantation kept in a high state of cultivation The implements used were the Simar Rototiller Nos 3 and 5 and the 'Monotrack' motor cultivator, the Planet Junior (garden tractor), the Gravely motor cultivator, and the Auto Culto motor cultivators, two types of the latter machine being used, one fitted with tines and the other with a 'one way' plough All implements, except the Simar 5 and the Auto Culto motor with plough, carried out cultivation between strawberry rows, the distance between the rows being about 2 ft 6 in Later in the day all implements except the Auto Culto plough worked among raspberry canes, the width cultivated being about the same (2 ft 6 in) The Auto Culto ploughed on land from which broccoli crop had been taken The demonstration, which was very well attended and carried out under favourable weather and soil conditions, proved entirely successful, all implements working successfully

THE subject selected by the Exhibition Committee for this year's exhibition at the Royal Institute of British Architects is "The Architecture of Modern Transport" It will consist of photographs, drawings, and models of architectural and decorative subjects connected with modern transport, and is intended to illustrate the latest developments both in Europe and America The types of work will include railway stations, signal boxes, various types of railway coaches, docks, harbour works, canal power stations and locks, liners and yachts, bus and coach stations, garages and filling stations, trams, buses, charabancs and private cars, bridges and viaducts, pylons, traffic control stations, hangars and aerodromes, aeroplanes and airships, lifts and moving stairways The exhibition will be formally opened by Mr H G Wells on April 21, at 3 P M, and it will remain open until May 22 Admission will be free

ANOTHER of the well-known and valuable catalogues (No 443) of Messrs Bernard Quaritch, Ltd, 11 Grafton Street, W 1, has reached us It gives the titles of, and in many instances useful bibliographic notes upon, upwards of 1500 works on botany, agriculture, forestry, fruit culture, gardens and gardening, herbals, early medicine and surgery, tobacco, etc, and should be obtained by collectors

MESSRS Dulau and Co, Ltd, 32 Old Bond Street, W 1, have just issued Catalogue No 183 of some 695 second-hand books on gardening and botany, including materia medica, pharmacy, perfumery and scent, from the libraries of the late Mr E M Holmes, curator of the Museum of the Pharmaceutical Society, and the

late Mr W Davis, collector for Messrs Veitch The same firm has also circulated a short handy list of useful books on gardening Both catalogues may be had free of charge on application

A CLASSIFIED list of second-hand instruments has recently been published by Messrs C Baker, 244 High Holborn, London, W C 1 The list is divided into ten sections, comprising microscopes and cognate apparatus, surveying instruments, astronomical instruments, spectroscopes, projection apparatus, including lanterns, slides, and projection microscopes, field glasses, chronometers, anemometers, thermometers, barometers, balances, hydrometers, various kinds of physical apparatus, such as polariscopes, voltmeters, and galvanometers, and photographic apparatus Apparatus can also be had on approval or on hire

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A sugar-cane mycologist and a research assistant each at the Agricultural Research Institute, Pusa India, for research into mosaic and other diseases of sugar cane —The High Commissioner for India (General Department), India House, Aldwych, W C 2 (April 20) A lecturer in geography at the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth (April 25) A lecturer in metallurgy at the Bradford Technical College—The Principal, Technical College, Bradford (April 30) A lecturer in philosophy at Armstrong College, Newcastle upon Tyne—The Registrar, Armstrong College, Newcastle upon Tyne (May 2) A draughtsman under the Ministry of Agriculture and Fisheries—The Secretary, Civil Service Commission, Burlington Gardens, W 1 (May 7) A chief research worker in the Nutrition Research Laboratories of the Indian Research Fund Association—The Secretary, Indian Research Fund Association, Simla, India (June 1) Teachers of woodwork under the Kent Education Committee—The Director of Education, Springfield, Maidstone A handicraft teacher (wood and metal work) under the Norfolk Education Committee The Secretary, County Education Office Stracey Road, Norwich

Our Astronomical Column

Comets —Prof G van Biesbroeck records, in *Pop Astr* for March, a remarkable increase of light in comet Schwassmann Wachmann (1), which passed perihelion nearly six years ago, and is now more than seven units from the sun In the middle of January, its magnitude was 17½, but on Feb 11 it had risen to 12½, thus showing a hundred fold increase in the light There was a somewhat similar, but less intense, outburst in December 1929, the magnitude then rising from 17 to 13½ Both the outbursts were short lived, the additional light fading after a few days It would seem that the cause of the outbursts must be sought in the comet's nucleus, rather than in the sun, but its nature remains a mystery A somewhat parallel case was presented by the two successive outbursts of light of Holmes's comet, at its first apparition in 1892 That comet was, however, much nearer to the sun, less than three units

Prof van Biesbroeck continued his observations of three other comets during February Stearn's comet has now been observed for four years, and is distant from the sun 11½ units, establishing a record in that respect Beyer's comet is still of magnitude 14½, and promises to be visible for several months more Comet Tempel (2) has been observed for six months, but is now lost in the sun's rays

Prof Nakamura gives some more details, in Kwasan *Bulletin* 192, of the object that he discovered last November it was called comet 1930 *g*, but it may be a minor planet, it looked quite sharp on some days, but on others had a nebulous appearance Positions are given for Nov 16, 17, and 18, plates were exposed on it until Nov 28, but it faded rapidly, and no images have yet been detected after Nov 18

The search for Encke's comet has been fruitless, it must now be left to southern observers to pick it up after perihelion passage, which occurs on June 3 It will be too near the sun until then to make detection possible

Distances of the Cepheid Variables —Very wide use has been made of the principle, first discovered by Prof H Shapley and his assistants, that the period of variation of a Cepheid gives a measure of its absolute magnitude, and consequently of its distance The distances of the globular clusters and of the spiral nebulæ are chiefly based on this method The graduation of the scale of absolute magnitudes involves the finding of the distances of the nearer Cepheids, this is a difficult matter, as they are too distant to obtain accurate trigonometrical parallaxes Estimates were made from their proper motions, but as these are small, it was known that the adopted values are subject to correction *Ast Jour*, No 951, contains a new discussion of their distances by B P Gerasimovic He redetermines the proper motions with the aid of recent catalogues, and also makes some use of the radial velocities, using the radial motion due to galactic rotation in the same manner that Dr J S Plaskett has done for the *B* and *O* stars He finds that for stars with period 4 days, Shapley's absolute magnitudes need to be increased (that is, made fainter) by 0 9 magnitude, while for 8 day and 16 day periods the increases are 0 8 and 1 2 magnitudes He adopts 1 0 magnitude in the mean as the average increase needed for the Shapley absolute magnitudes This implies that distances found from the Shapley curve need to be reduced in the ratio 0 631 to 1, or about 5 to 8 R E Wilson had suggested 0 7 to 1, which is in fair accord, but the much more drastic reduction of Shapley's distances in the ratio of 0 13 to 1, suggested by Curtis, Kapteyn, and van Rhijn about ten years ago, is shown to be improbable

Pluto —A further article on Pluto by Prof H N Russell appears both in the February number of the *Scientific American* and the February number of the *Journal* of the Royal Astronomical Society of Canada It describes the barycentric orbit, deduced by Nicholson and Mayall as a simple method of allowing for the greater part of the action of the other planets upon it Their period is 247 69 years, which is so close to 1½ times Neptune's period that it will need an interval of some 40,000 years to elapse before Pluto and Neptune are at their minimum distance from each other The work of Nicholson and Mayall indicates that Pluto's mass is probably comparable with that of the earth Prof Russell notes that if Pluto's albedo is the same as that of the lunar maria, its diameter would be about equal to that of the earth.

Research Items

Ancient Man in the Gipping-Orwell Valley—The *Proceedings* of the Prehistoric Society of East Anglia for 1930, vol 6, pt 3, contains a study of the deeply buried deposits of the non tidal valley of the Gipping above Ipswich and the tidal part of the valley of the Orwell below Ipswich These deposits lie in deeply cut and steep sided channels, filled apparently with glacial material buried beneath the deposits lying on the floor of the present valley They are evidently of high antiquity (I) The Gipping Valley (1) After the retreat of the ice which laid down the Upper Chalky Boulder Clay (third glacial epoch of East Anglia) and while climatic conditions were still severe, Aurignacian peoples were living in the valley Afterwards 11 ft of gravel was laid down, with an increase of cold conditions It is possible that one bed represents the fourth glacial epoch of East Anglia, and that the flint implements it contains were swept down and redeposited over the slightly less old implements found beneath (2) The Flood Plain Terrace In ascending order are encountered (a) a Combe Capelle floor of Early Mousterian age, (b) Early Solutrean, fine flint blades in loam belonging to the third inter glacial period below Flood Plain gravel Mammalian bones, among them the mammoth, belong possibly to this horizon (3) The gravel of the Flood Plain Terrace of post Early Solutrean age contains a large number of derivative flakes and implements, to be associated with the passing away of the fourth glacial epoch, the Boulder Clay of which contains implements of upper palæolithic type (4) The beds above the Flood Plain Terrace From the loamy peat deposit have been recovered a number of long, thin blades of flint probably of Magdalenian age (II) The tidal portion of the Orwell Valley Overlying the basal gravel is a bed of compact peat from which it is probable there came a skull comparable with the Tilbury skull and possibly contemporary with the Combe Capelle type of implement Above the lower peat is a shingly gravel capped by peat and mud in alternate layers From the base of the alluvium probably came implements exhibiting affinities with the Magdalenian In both the Gipping and Orwell valleys the neolithic period is represented, both geologically and archæologically only in the superficial beds

Song of the Skylark There have been many opinions expressed as to the length of time occupied by the song of a skylark Opinions would have been fewer and more consistent had each observer taken the trouble to time more than a thousand songs, as Noble Rollin did before writing a short paper on the subject (*Scottish Naturalist*, 1931, p 47) Variations in length occur according to the time of day, the month of the year, and the idiosyncrasy of the birds themselves, so that the range runs from 1 to 19 minutes But the average length was only 2 22 minutes A series of graphs illustrates time variation in successive songs, the average length of song for each month (ranging from 1½ minutes in July to 3 minutes in September), and the percentage occurrences of various song lengths in different months

Intelligence of a Raccoon—Experimental tests made by Prof Wm McDougall with the object of discovering whether a raccoon was capable of foresight are recorded in a *Daily Science Bulletin* issued by Science Service, of Washington, D C The animal was trained to look in a box for food Then a latch was put upon the box, pivoted on a screw so that a light push in the right direction would release the lid The raccoon having unsuccessfully tried to raise the latched lid, in a few seconds opened the latch and secured the food One by one, other latches were added, each new latch in the series holding the one attached previously, so that each had to be released in order before the next could be moved Thus a complicated series of 24 latches was built up, extending all round the box After the first few attempts, the raccoon never attempted to reach the food directly, but attacked the latches at once, and so efficient did she become that she was able to manipulate the series of 24 and open the box in a few seconds When some of the series were left open, she would pass them by untouched, in order to proceed to the closed latches Prof McDougall, whose full report will appear in the *Journal of Comparative Psychology*, regards the behaviour of the raccoon as showing that its actions were governed by foresight of the result of the actions

Bacteria in the Sea—Miss Blodwen Lloyd in her paper "Bacteria of the Clyde Sea Area a Quantitative Investigation" (*Journal of the Marine Biological Association of the United Kingdom*, **16**, 3, 1930) summarises her results of sampling three stations at regular intervals over a period of one year, together with further occasional samples from other localities The stations chosen were at Loch Striven, Loch Long, and Greenock, representing areas respectively free from pollution, moderately free, and highly polluted The apparatus used for vertical sampling is simple and the technique for the routine work follows as nearly as possible the procedure recommended by the American Society of Bacteriologists for standard examination of water, with some modifications The incubation temperature was lower by some six to twelve degrees than that usually employed, in order to encourage the growth of true water bacteria and to discourage other bacteria which thrive at higher temperatures The counts were made directly and the dilution method was not used The largest number of bacteria was found in the surface waters, decreasing with increasing depth until, at the bottom, there was a slight increase The numbers were remarkably constant throughout the year for all layers, with only slight evidence of rhythmic variations, except at the surface, where the numbers fluctuated considerably In the daytime the bacteria at the surface are irregular in number, but in the lower levels there is a slight increase during darkness Loch Striven and Loch Long are very free from pollution, but in Cumbrae Deep and in the estuary off Greenock the numbers are high, with a large proportion of what are presumably coliform bacteria

Alcyonaria of the Faroes—The Alcyonaria of the Faroes are for the first time described in detail by Dr P L Kramp ("Zoology of the Faroes", edited by Ad S Jensen, W Sundbeck, and Th Mortensen 1930 Vald Pedersens) Six species of Alcyonaria are known from the Faroes, all mainly boreal, and from the deeper water, about 400 650 metres around the Faroe plateau, five more are added The two littoral species *Alcyonium digitatum* and *Virgularia mirabilis* are very common, having their principal area of distribution south of the Faroes, but they are also found somewhat farther north *Alcyonium* likes a hard bottom and *Virgularia* likes a soft bottom No species with distinctly northern distribution has been found on the Faroe plateau The gorgonacean, *Stenogorgia borealis*, was named, but not described, in 1915 by the late Prof Jungersen in "Conspectus Faunæ Groenlandicæ" Dr Kramp, who has examined all Prof Jungersen's material, now describes this species in detail with good figures It differs from

other species of the genus in the tentacles being always completely destitute of spicules, but it closely resembles them in many other ways and undoubtedly belongs to this genus

Rafinesque's Types of Helices —H A Pilsbry (*Proc Acad Nat Sci*, Philadelphia, 82, pp 321 326, 1930) discusses the types of Rafinesque's genera of Helices Rafinesque published in 1818 a list of generic names, without descriptions or species, which was therefore of only historic interest The terrestrial genera were *Limax*, *Helix*, and seven new genera which he described in two papers, one in 1819 and the other in 1831 Mr Pilsbry considers each genus in turn, and indicates the species he considers should be taken as the type for those genera which are held to be valid For the genus *Aplodon* with three nodose whorls no satisfactory explanation has hitherto been forthcoming, for, as Mr Pilsbry points out, there is no shell in Kentucky (the area from which Rafinesque collected) which offers the slightest approach to the description But if it be supposed that Rafinesque had a stray marine shell among his Kentucky collections, the case becomes clear, for the description applies perfectly to the common species *Modulus modulus* (L) from Florida and the West Indies Mr Pilsbry is in no doubt as to the identity, and as *Aplodon* is prior to *Modulus*, he suggests that the generic name of the common marine shell be changed accordingly

Fresh-water Diatoms —The survey of fresh water Bacillariales of Devonshire by G T Harris (*Trans* of the Dev Assoc for the Advancement of Science, Lit, and Art, 1930) represents a large amount of work, extending over four or five years The field is one to which little attention has been paid and it would be interesting to know how surveys of other counties would compare with Devonshire Harris records 232 species from Devon, whilst West and Fritsch in the last edition of "Freshwater Algæ" say that about 250 species occur in the British area, which suggests that either Devon is extremely rich in species or else that the total number for Britain should be considerably higher In connexion with this, it may be significant that Harris finds the majority of the species more or less indifferent to habitat, so that it is possible that the diatom floras of different parts of the country might show less variation than is found in the case of other groups of plants As the number of species of diatoms is so large, the author is certainly wise, at this stage, to limit the records to well defined species and not to multiply the number by including doubtful species or by taking into account varietal differences

Significance of Relative Sexuality —Max Hartmann gives an interesting survey of the possible influence of external and internal factors on sex determination in Thallophyta in *Die Naturwissenschaften*, Heft 1, 1931 The facts bring out clearly the bi sexual potentialities of the sexual cells or gametes, but the fact that one sex always dominates, suggests that some realising factor is superposed, so that, regardless of external factors, any sexual cell has a definite tendency towards a particular sex The realising factor may be unequally distributed at meiosis, a clear example of which is *Gonium pectorale*, in which the four-celled cœnobium is built up of two cells of male tendency and two of female In this, and in the majority of cases, the sex appears to be fixed, though in some cases the sexual cells may occur in such close relationship to one another that it would be interesting to know what determines the behaviour Examples of *Achlya americana* have been observed in which the antheridial tube originated from an oogonium, and also others in which an antheridial tube, after fertilising an oogonium, grew on and produced a terminal oogonium Very interesting, from this point of view, is the work of Hartmann on *Ectocarpus siliculosus*, and of Jollos on *Dasycladus clavæformis*, where, by testing the gametes from different plants in various combinations it was shown that not only could they be grouped as male or female, but these groups could be subdivided according to the intensity of the sexual tendency Still further, if gametes of the same sex but of sufficiently different intensities were brought together, the gamete of weak intensity might actually behave as one of the opposite sex and copulation take place These two algæ present a good illustration of the bisexual potentialities of sexual cells and of the fact that normally the dominant sex is determined by some internal factor, but if this 'realising' factor is weak, then an external factor, such as the proximity of another gamete of stronger sexual tendency, may actually determine the behaviour So that we have here a typical example of relative sexuality

Soil Sterilisation —The value of soil sterilisation (or more strictly speaking, partial sterilisation) for the control of injurious insects and fungi and for effecting changes that lead to better cropping has proved so considerable that, at the invitation of the Ministry of Agriculture, Dr W F Bewley has prepared a bulletin on the subject entitled "Practical Soil Sterilisation" Growers of glasshouse produce no longer regard these operations as expensive luxuries and in market garden and propagation work they may also be carried out with advantage Sterilisation can be effected either by steaming, baking, or treatment with chemicals such as cresylic acid or formaldehyde, but of these the steaming method is the most strongly recommended, treatment once in four years being sufficient Baking is also reliable when the quantity of soil is relatively small Chemical treatment, on the other hand, is less satisfactory, and must be carried out each year to be effective Full working details, with costs, of the various methods are supplied and their relative merits discussed Attention is also directed to the fact that care is needed in the manurial treatment after steaming, for the soil tends to become specially rich in nitrogen and will require the addition of phosphate and potash only to secure a proper balance The use of stable manure may in such cases prove harmful The bulletin, No 22, which may be obtained direct from the Ministry of Agriculture 10 Whitehall Place, S W 1, price 1*s* post free, should prove of great value to all those interested in glasshouse crops, but growers are advised to consult an expert before undertaking sterilising operations for the first time

Raised Beaches of New Zealand —The recent disastrous earthquake in New Zealand lends additional interest to an investigation by L C King of the raised beaches of the south east coast of North Island (*Trans and Proc N Z Inst*, Vol 61, pp 498 523, 1930) It is shown that the coast line is one of emergence, except at Port Nicholson (a local downwarp) and Palliser Bay (a fault angle depression) Along most of the coast line studied, uplifted terraces of undoubted marine origin testify to the amount of comparatively recent uplift from place to place, and demonstrate that the movements were not uniform, but consisted of a series of interstage warpings and tiltings The two main terraces suggest a general axis of tilting somewhere in Cook Strait From Terawhiti to Black Rocks, the higher of these rises from 250 ft to 950 ft, and the lower from 125 ft to

700 ft The platforms are carved in hard greywacke A lower beach at 25 35 ft indicates that one of the latest movements of the coast appears to have been a general uplift of approximately 30 ft along almost the whole length described The paper is well illus trated and includes a useful critique for the discrimina tion between marine and alluvial terraces

Diffraction of Electrons in Gases - Many diffrac tion experiments have now been performed in which electrons or atoms are made to exhibit undulatory properties in interaction with periodic structures The *Proceedings of the Royal Society* for March con tains accounts of two sets of experiments which fur nish what is practically the electron analogy of the formation of haloes by clouds of fine particles of water, that is, diffraction by an obstacle the dimensions of which are comparable with the wave lengths of the electrons In the one case, studied by E C Bullard and H W Massey, the obstacles were the individual atoms in argon, in the gaseous phase, and in the other, studied by F L Arnot, atoms in mer cury vapour In both cases the apparatus was quite simple in principle, a beam of electrons was pro jected with definite speed into the gas or vapour at low pressure, and the electrons, which were scattered from a small volume into a Faraday cylinder without loss of energy, were measured for various orientations of the projecting and collecting systems The curves showing the variation of the current scattered, with angle of scattering, exhibit series of maxima and minima, which change in position as the energy, or wave length, of the electrons is changed The full theory of this type of scattering has not yet been developed, a fundamental difficulty occurring from the fact that the wave lengths of the electrons alter as they are accelerated or retarded in the fields of the scattering particles, but the qualitative course of the effect is what would be anticipated, and, in the case of argon, there is fair agreement between the results which have been obtained and those of Ramsauer for the effective cross section of the atom for slow electrons of various speeds

Gas Analysis Apparatus - The Bureau of Standards *Journal of Research* for January contains a paper by M Shepherd in which an improved volumetric apparatus is described for the analysis of gases by combustion and absorption methods, with details of manipulation The apparatus is of the Orsat type, that is, the series of pipettes is connected to the burette, but the adjustment and control of pressure balances have been greatly improved The combustion and absorption pipettes have been redesigned, and a new type of mounting permits the easy removal and replacement of any part It is suitable for rapid technical analysis Very complete details of construc tion and use are given

Chemistry of Disinfection — In a paper on the chemistry of disinfection, in the February number of the *Journal of Physical Chemistry*, W D Bancroft and G H Richter, from ultramicroscopical observa tions on the colloidal changes in living cells and bacteria, conclude that antisepsis in bacteria is merely a state of narcosis depending upon the reversible coagulation of the cell colloids Disinfection is brought about by the irreversible coagulation of the cell colloids The observations have shown that other means—action of heat, light, distilled water, or mechanical agitation—which produce coagulation also produce antisepsis or disinfection The mechanism of disinfection consists of two phases (1) the adsorption of the drug and (2) coagulation of the cell colloids, and the phenomena of stimulation are associated with the decreasing stability of the cell colloids in the initial stages of coagulation Drug tolerance is similarly attributed to fractional coagulation, with adsorption of the drug by the coagulum and simultaneous in creased stability owing to dilution of the sol Anti septics and disinfectants, like narcotics, can thus act in two ways, either directly coagulating the colloids, as in the case of phenol, or by interference with the normal cell functions so that accumulated toxic pro ducts produce the coagulation Arsenic derivatives appear to act in the latter indirect way

Diphenyl and its Derivatives —The *Journal of the American Chemical Society* for January contains a paper by Clark and Pickett on the X ray investigation of diphenyl and some of its active and inactive de rivatives It is known that substitution of certain groups in the 2, 2′, 6, 6′ positions in diphenyl gives rise to compounds which may be resolved into stereo isomers, and it is thought that the presence of suffi ciently large groups prevents the free rotation of the two rings and hence two active forms of such a com pound exist The examination of such compounds by X-rays should throw much light on their structure So far as the investigations have gone—and it is em phasised that accurate measurements of intensities are still required before certainty can be reached— they indicate that the two benzene rings in diphenyl are in prolongation of each other rather than doubled over each other, and this is also the configuration accepted by most organic chemists The rings are probably puckered, not flat, a conclusion also reached by Hengstenberg and Mark The width of the molecule is probably 5 6, the actual thickness less than 4 1, and the length greater than 9 5 The carb oxyl groups in diphenic acid probably exert forces upon each other which result in a doubling up of the molecule, a supposition which is in agreement with the ease of formation of an anhydride of this acid The thickness of the molecule is constantly 4 3 for the derivatives of diphenyl The width is 7 9 for hexachlorodiphenyl, and the length 10 75 The values for dimesityl and its diamino derivative indi cate a tilt of the rings

Barley Proteins - A contribution to this subject from the Tuborg Laboratories, Copenhagen, by G Hofman Bang appears in the February issue of the *Journal* of the Institute of Brewing (37, 72, 1931) It was found that the proportion of insoluble proteins (glutelin) varies according to the variety of barley, but that, for one particular variety, it is constant and independent of the soil conditions The salt soluble proteins decrease and the alcohol soluble proteins (hordein) increase with increase in the total protein content of the barley, though after drying there is an increase of both hordein and salt soluble proteins and a decrease in glutelin A conversion of salt-soluble protein into glutelin occurs, without, however, a change in hordein content, on storage of the barley At 20° C with samples containing 11 per cent or less of moisture this change is very slight, but the rate of reaction increases with increase of either temperature or moisture content These results are of consider able importance in their relation to the changes under gone by barley during malting, but they are also of great interest in that they substantially confirm, for Danish barleys, the relationships between the in dividual proteins already established by Bishop in Great Britain Some work has also been carried out on the influence of various practical malting con ditions on these relationships, and it has been shown that in the presence of large proportions of carbon dioxide germ-growth is checked and an accumulation of salt-soluble proteins in the malt is promoted

Pyrethrum as an Insecticide and its Cultivation in England

By J C F FRYER and C T GIMINGHAM, Plant Pathological Laboratory, Ministry of Agriculture

THE insecticidal properties of the flowers of certain species of pyrethrum (*Chrysanthemum*) have been known for a long period, the very high toxicity of the active principles to insects and their harmlessness to man and warm blooded animals forming an almost unique combination of qualities It is, however, within the last decade only that the chief advances towards a detailed knowledge of these plants have been made, and the marked interest aroused in the subject recently makes it appropriate to direct attention to the present position of investigations undertaken in Great Britain

Three species of pyrethrum, *Chrysanthemum cinerariæfolium* Trev, *C coccineum* Willd, and *C marschalli* Ascher (*roseum* Bieb), possess insecticidal properties Of these, the first named is much the most important, its flowers constitute the great bulk of the pyrethrum of commerce, and the work to be referred to has been confined almost exclusively to this species The plant is a native of the Mediterranean coast region, and is widely cultivated there and in Japan *, it is now also grown commercially for home consumption in Switzerland, France, and North Africa

Experiments on the cultivation of pyrethrum in England were started in 1925 by the Plant Pathological Laboratory of the Ministry of Agriculture,[1] small plots being laid down at some sixteen centres on a variety of different types of soil In co operation with the Insecticides and Fungicides Department of Rothamsted Experimental Station, samples of the produce from many of these plots during the years 1926–29 were tested by a biological method and later examined chemically (see below), and, without going into details, it may be said that the result of these experiments has demonstrated that pyrethrum can be grown and harvested successfully under English conditions, that the average yield of dried flowers is of the same order as that obtained elsewhere, and that the insecticidal efficiency of the product is not less than that of imported samples[2] The plants proved quite hardy and successfully withstood the fairly severe winters of 1927–29, a plot at Harpenden, planted in 1926, is still in good condition and gave its highest yield of flowers in 1930 These experiments, however, were on too small a scale to give data on which an opinion could be formed as to the economic possibilities of growing pyrethrum in England, and arrangements were therefore made to plant up several larger areas of ¼ to 1 acre, for which detailed costings could be kept Four of these bigger plots yielded their first harvest of flowers in 1930, and another should come into bearing this year It will be necessary to continue these investigations for several years before the desired information is obtained, but the first year's figures are, on the whole, not discouraging, though in one case the grower considered the crop too troublesome and has decided to discontinue the experiment The produce from all four plots was of high quality, two gave a yield which is about the average for a first year crop, the yield from the third was rather below the average, and from the fourth was very much higher Costs of planting and cultivation are much greater in the first year than later, but reckoning the produce at the current price of imported flowers (at present rather low), expenses were about covered in the case of the fourth plot These plots should continue to crop for at least another four years, during which the expenses of cultivation will be greatly reduced Thus, although the results so far obtained do not warrant confidence as to ultimate success, they certainly justify the continuation of the experiments Cutting the flowers by hand is probably the most serious item of expense, and labour costs will be considerably reduced if a mechanical means of harvesting can be devised

Laboratory investigations have proceeded concurrently with the field experiments The brilliant investigations of Staudinger and Ruzicka[3] elucidated the composition of the active principles of pyrethrum and showed that these were two esters of complicated structure, to which the names pyrethrin I and pyrethrin II were given A method for the determination of these substances was also suggested by Staudinger and Harder[4] Following up these researches, analytical methods, involving the use of only small amounts of material, were worked out at Rothamsted, and a number of samples were examined both biologically and chemically A close correlation was found between the percentage of pyrethrins in a series of samples and the observed insecticidal efficiency under standard conditions[5]

Another point to which special attention has been given is the relationship between the stage of development of the flower and the pyrethrin content It is an established convention in the trade that pyrethrum flowers picked before they are fully open ('half opened') possess greater insecticidal value than the fully opened flowers, and higher prices are given for the former † Biological experiments carried out under standard conditions have, however shown that the toxicities of extracts of equal weights of pyrethrum flowers at different stages of development do not differ significantly,[2] and a detailed investigation by Dr F Tattersfield (not yet published) of the pyrethrin content of flowers taken week by week over the flowering period, in which the large mass of data obtained is dealt with statistically, shows that the percentage of pyrethrins present increases up to the stage at which the flowers are fully open Gnadinger and Corl,[6] in America, using a different analytical method, have also found that the pyrethrin content of the flowers increases with maturity The point is of great practical importance, since the yield both of flowers and of active principles which can be harvested per unit area increases markedly with increasing maturity of the flowers

Evidence has accumulated in the past two years that many samples of pyrethrum grown in England contain a higher percentage of pyrethrins than is generally found in imported consignments Figures of 1 5–2 0 per cent are not uncommon, whereas imported samples commonly contain not more than 0 5 per cent Further, analysis of the flowers of individual plants have shown wide variations in pyrethrin content, and the possibility of evolving improved strains is under consideration

Pyrethrum insecticides were formerly confined very largely to powders obtained by grinding the dried flowers, but in recent years preparations for use as horticultural spray fluids have been on the market in America, and kerosene extracts of the flowers have been widely sold as fly sprays As was pointed out by Staudinger and Ruzicka, the pyrethrins undergo hydrolysis with alkalis, and

* Japan now provides about 70 per cent of the world's supply of pyrethrum For details of the history and present position of pyrethrum growing in Japan and the methods of cultivation adopted, see an article by the British Vice-Consul at Seoul in *Bull. Imp Inst*, Oct 1930, p. 300

† This opinion had been challenged by Swiss, French, and American workers many years ago, but without affecting the custom of the trade

preparations containing soap, such as the French 'savon pyrethre', are liable to gradual deterioration, petroleum extracts with a non alkaline emulsifier are however, stable for considerable periods A formula for the preparation of a spray fluid of the latter type has been published by Tutin,[7] and proprietary products of a similar kind were placed on the English market last year

Walton [8] has obtained very promising results with sprays of this type for the control of the raspberry beetle, a serious pest of raspberries and loganberries, and preliminary experiments with these fluids against red spider and against the apple capsid bug, both important pests of fruit and difficult to control, have also been successful Although different kinds of insects vary somewhat in the degree of resistance that they offer to the effects of pyrethrum, a great many important pests are killed by preparations containing 0 0025 to 0 005 per cent of pyrethrins, that is, approximately the equivalent of 0 5 to 1 0 per cent of flowers The pyrethrins appear to act upon insects as nerve poisons, and they are undoubtedly among the most powerful insecticides known, the range of their usefulness has by no means yet been fully explored

[1] J C F Fryer and R Stenton, *Min Agric* 33 916, 1927
[2] J C F Fryer, F Tattersfield, and C T Gimingham, *Ann App Biol*, 15, 423 1928
[3] *Helv Chim Act*, 7, 177, 1924
[4] *Ann Acad Sci Fennicæ*, A, 29, No 18 1927
[5] (a) F Tattersfield, R P Hobson, and C T Gimingham, *J Agric Sci*, 19, 266, 1929
(b) F Tattersfield and R P Hobson, *J Agric Sci*, 19, 434 1929
(c) J T Martin and F Tattersfield, *J Agric Sci*, 21, 115, 1931
[6] *J Amer Chem Soc*, 51 3054, 1929 52, 680, 1930
[7] F Tutin, *Long Ashton Res Stat Rept*, p 96, 1928 p 98, 1929
[8] C L Walton *J Pom and Hortic Sci* 8 178, 309, 1930

Geology in Great Britain

THE "Summary of Progress" of the Geological Survey of Great Britain for 1929 is issued in three parts, of which the first is devoted to an account of the routine work during the year under review, while the others contain papers on subjects of special interest Part 1[1] embodies the annual reports of the Geological Survey Board and of the Director Sixty six maps were published during 1929, with eight memoirs which, with the exception of that dealing with Moreton in Marsh (see below), have already been noticed in our columns (NATURE, Aug 16 1930, p 258) The memoirs in the press at the close of the year have since appeared and are reviewed below

The most important event in the progress of the Survey during 1929 was the beginning of operations for the building of a new museum, library, and offices on a site in Exhibition Road South Kensington, midway between the Natural History Museum and the Science Museum The Geological Museum will have direct connexion with each of these by means of passages open to the public The work now in progress will take at least three years to complete New offices have been occupied in Edinburgh and a scheme for the erection of an additional building is under consideration Field work has for some years been concentrated on the revision of the coalfields In Yorkshire Lancashire, and Northumberland this is still actively in progress, elsewhere the surveys are approaching completion, though the maps and memoirs have still to be published Reports on six districts in England and four in Scotland, and on the palæontological, petrological, and chemical work in progress, contain many records of current interest

In Part 2[2] the results of a magnetic survey of part of north Leicestershire are recorded and discussed by A F Hallimond A valuable petrological study of the hornfelses from Kenidjack, Cornwall, is provided by C E Tilley and Sir John Flett It is thought that the original dolerite intrusions of the area were intensely weathered and leached, and afterwards sheared and thermally metamorphosed with the production of cordierite anthophyllite rocks and cummingtonite rocks In view of the occurrence of similar rocks elsewhere in puzzling circumstances, this paper is of much more than local importance H G Dines and F H Edmunds show conclusively that it is unsafe to base stratigraphical deductions on mechanical analyses of the formations of the Lower Greensand Four other papers record noteworthy stratigraphical and palæontological observations

Part 3[3] contains an account of magnetic work on the Swynnerton Dyke, also by A F Hallimond Sir John Flett describes a teschenite, 224 feet thick, encountered in a boring at Easter Dalmeny, west of Edinburgh, and devotes special attention to the variation of mineral composition and specific gravity with depth The discussion of differentiation is particularly illuminating and should be seen by all petrologists Bernard Smith contributes a useful study of the origin of the St Bees Whitehaven Gap Important palæontological investigations are recorded in R Crookall's account of *Palæoxyris* and related genera, and in W S Bisat's paper on the goniatite and nautiloid fauna of the Middle Coal Measures of England and Wales The accurate determination of hitherto confused species makes possible a notable advance in the correlation of the English and German Coal Measures Other papers deal with the Pliocene of Hertfordshire and a boring in the Lower Oil shale Group of Burntisland

Few memoirs in recent years have approached that dealing with north Ayrshire,[4] in the wide variety, general interest, and scientific importance of the topics discussed The area is characteristic of much of the Central Valley of Scotland, and includes a long succession of sediments from the Downtonian to the New Red Sandstone, and a remarkable number of igneous episodes of different ages Lava suites occur in the Lower Old Red Sandstone, Calciferous Sandstone, Millstone Grit, and New Red Sandstone (? Permian) In addition, beds of volcanic ash occur at intervals in the Limestone Coal and Upper Limestone Groups, and there are many north west dykes that can confidently be referred to the Tertiary A remarkable range of petrographic types is represented, and petrologists abroad, as well as at home, will find the memoir a rich storehouse of highly significant records, analyses, and associations A summary of the geology and an account of previous researches are given in the first two chapters The chief rock groups, sedimentary and igneous, are ably dealt with in successive chapters Special attention is directed to the fauna of the Carboniferous and the flora of the Coal Measures A detailed account of the glaciation of the district follows and includes a description of fossiliferous beds of Pleistocene age found beneath the boulder clay of certain areas A special feature of the memoir is the chapter on the soils and agriculture of north Ayrshire It should be noted that in addition to the beautiful one-inch maps (Solid and Drift editions) published in 1928, a soil texture map on the same scale is also available The latter was issued in 1929 and was prepared under the supervision of the late Prof R A Berry

The new memoir on the Alnwick district[5] deals with the country stretching from the Cheviot foothills to the coast between Warkworth and Embleton, and includes some of the chief beauty spots of North-

umberland The rocks are mostly of Lower Carboniferous age and the diversity of sediments affords many interesting problems Of special interest is the famous Shilbottle coal, the most valuable Lower Carboniferous seam in the north of England Chapters are devoted to the Whin Sill, glacial, and post glacial deposits, and economic geology Details of borings and sinkings made in recent years are given in an appendix, and there is a useful glossary of the local and mining terms of north Northumberland

The Maryport memoir[6] covers part of the West Cumberland coalfield and is the first systematic account of a difficult and intricate region Most attention is given to the Productive Coal Measures their correlation with the seams in other parts of the field, the complicated faulting of the strata, and the structural features of the adjoining concealed coal field The whole district has been heavily glaciated, exposures are few, and detailed mapping has been largely dependent on mining information The remaining chapters deal with the Skiddaw Slates the Carboniferous Limestone the Whitehaven Sandstone series, the New Red Sandstone, glacial and recent deposits, and the economic geology of the district

The memoir[7] describing Sheet 77 deals with a region of great industrial importance, extending from Blackstone Edge Moors to Dewsbury, and embracing Huddersfield, Halifax, Batley, Brighouse, the southern part of Bradford, and some of the suburbs of Leeds The region lies on the easterly dip slopes of the Pennines, and, apart from the superficial deposits, the rocks all belong to the Millstone Grits and the Lower and Middle Coal Measures The geology of these formations is fully discussed, and there are chapters on structure, glacial deposits, local fossils, and economic geology, special attention being devoted to the goniatite zones and to the occurrence of marine bands in the coal measures Records of borings, a list of quarries, and a list of geological photographs (of which prints and lantern slides can be supplied) are given as appendices

The district represented on Sheet 217 is an attractive residential and agricultural area in the Cotteswolds ranging from Cheltenham to Chipping Campden[8] Roughly, about half the region is in the Severn basin and about half in the Thames basin Apart from the superficial formations, which are here of great variety and interest, and the concealed Palæozoic floor, the rocks belong to the Lower and Middle Jurassic Since the days of Murchison (who described the geology in 1834) the area has provided an attractive field for many active workers, including the late S S Buckman and the author of the memoir Mr Richardson has demonstrated, for the first time, the relationships of the Estuarine deposits of southern Northamptonshire and northern Oxfordshire to the marine Inferior Oolite of the Cotteswolds The memoir is an admirable guide to the geology of a classical and much visited region

The next two memoirs belong to the county series in which the sources of underground water are recorded The Worcestershire volume[9] provides an excellent short account of the geology and structure of the county, and is illustrated with a clear map and several sections The chief regional water undertakings are covered, and the supplies of the rural and urban areas are described in detail Special attention is given to the waters of Malvern and Droitwich, and a comprehensive series of water analyses is provided by the county analyst, Mr C C Duncan The Gloucestershire memoir[10] is of unusual interest because of the great variety of rocks that occur in this variegated and delightful county As usual in this series, an admirable general introduction to the geology is provided, with maps and sections Detailed accounts of the water supplies of Bristol, Gloucester, and Cheltenham are given The saline waters of Cheltenham originate in the Lower Lias, while the chalybeate springs issue from a superficial gravel in which there is an admixture of peaty matter Other rural and urban district supplies are described with a wealth of detail, and numerous analyses and full bibliographies are added Twenty four memoirs on the underground water supplies of counties have been published to date

[1] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1929 Part 1 Pp iv + 100 2s net

[2] *Ibid* Part 2 Pp iv + 80 + 3 plates 2s net

[3] *Ibid* Part 3 Pp iv + 89 + 8 plates 2s 6d net

[4] Geology of North Ayrshire (Explanation of One Inch Sheet 22, Scotland) By J E Richey, E M Anderson, and A G MacGregor, with contributions from E B Bailey G V Wilson G A Burnett, and V A Eyles Palæontological Chapters by the late G W Lee and R Crookall and an account of the Soils and Agriculture by the late Prof R A Berry F M Melville and C Louden of the West of Scotland Agricultural College Pp viii + 398 + 10 plates 10s net

[5] The Geology of the Alnwick District (Explanation of Sheet 6) By R G Carruthers G A Burnett and W Anderson, with contributions by C H Dinham and the late J Maden Pp vii + 138 + 4 plates 3s net

[6] The Geology of the Maryport District (Explanation of Sheet 22) By T Eastwood Pp viii + 137 + 3 plates 3s net

[7] The Geology of the Country around Huddersfield and Halifax (Explanation of Sheet 77) By D A Wray J V Stephens W N Edwards, and C E N Bromehead Pp vi + 221 + 5 plates 4s 6d net

[8] The Country around Moreton in Marsh (Explanation of Sheet 217) By L Richardson, with contributions by A E Trueman, D M Williams R C Gaut and H G Dines Pp vi + 162 + 6 plates 4s 6d net

[9] Wells and Springs of Worcestershire By L Richardson, with contributions by Cecil Cooke Duncan and B Brotherton Pp vi + 219 + 1 plate 4s net

[10] Wells and Springs of Gloucestershire By L Richardson Pp vi + 292 + 1 plate 5s net

(London H M Stationery Office)

University and Educational Intelligence

Aberdeen —The honorary degree of LL D was conferred upon the following among others, at the graduation held on April 1 Sir Leonard Hill, Sir Frank Smith, Prof C R Marshall, and Sir J Arthur Thomson

Cambridge —The Appointments Committee of the Faculty of Economics and Politics will shortly proceed to appoint a University lecturer in statistics, the duties to begin on Oct 1 Candidates are requested to communicate with the Registrary of the University not later than May 1

The General Board has made the following grants from the Worts Fund £100 to the Zoological Station at Naples, £45 to Miss W Lamb, of Newnham College, for the continuation of her excavations at Thermi, £45 to Dr E B Worthington, of Gonville and Caius College, towards the expenses of the Cambridge Expedition to the East African Lakes, £45 to Dr L S B Leakey of St John's College, for archæological, palæontological, and geological investigations in East Africa, £45 to G Bateson, of St John's College, for anthropological work in New Guinea, £30 to R T Wade, of Clare College, towards his expenses in connexion with visits to museums in Europe to study fossil fish, £20 to P W Richards, of Trinity College, towards the expenses of a botanical expedition to the Sierra Nevada, £15 to T H Cox, of Magdalene College, for geological exploration in Baffin Land

It is proposed to confer the degree of Sc D *honoris causa* upon Prof J S Haldane, honorary professor and director of the Mining Research Laboratory in the University of Birmingham

Edinburgh —At the meeting of the University Court on Mar 23, a letter was read from Sir Alexander

Rodger, formerly Inspector-General of Forests, India, intimating that he desired to present a prize for the best student in forestry graduating in 1931, 1932, and 1933 The Court gratefully accepted this gift

The intimation of a gift to the University from an anonymous donor of £5000 towards the cost of furnishing the new Masson Hall, directs attention to a movement that is on foot to remove the present hall from George Square to a new site at West Mains Road, where it will be capable of accommodating about one hundred resident students in addition to the staff Plans have been prepared and the building will be proceeded with as soon as the necessary funds are available The estimated cost of the new building is £50,000

Prof James C Brash has been appointed by the curators to the chair of anatomy in the University, to succeed Prof Arthur Robinson, who is resigning at the end of the current academic year

LONDON —Miss G K Stanley has been appointed, as from Aug 1, to the university readership in mathematics tenable at Westfield College

It has been resolved to institute a university chair of experimental pathology tenable at the Cancer Hospital (Free)

The Petrie Medal for distinguished work in archæology has been awarded to Sir Arthur Evans

APPLICATIONS for Beit junior memorial fellowships for medical research can now be received They should be sent at latest during May to Prof T R Elliott, Beit Memorial Fellowships for Medical Research, University College Hospital Medical School, University Street, W C 1

A SPECIAL course of seven lectures on "Internal Combustion Engines and Lubrication" will be given by different specialists at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E C 3, on Mondays and Thursdays from April 13 to May 4 The course has been specially arranged for those engaged in the technical branches of the petroleum industry

A LIMITED number of agricultural scholarships for students who propose to take up posts as agricultural organisers, teachers or lecturers in agriculture, etc, are being offered by the Ministry of Agriculture and Fisheries Form No A 472/T G and particulars can be had from the Secretary of the Ministry, 10 Whitehall Place, S W 1 Completed forms are returnable by, at latest, June 15 The Ministry also invites applications for some research scholarships in agriculture and veterinary science Applications must be received not later than June 15 on Form 900/T G, which, with a copy of the conditions attached to the scholarships, may be obtained from the Secretary of the Ministry

NOTICE is given by the Institution of Electrical Engineers that the triennial award of the Coopers Hill War Memorial prize and medal will this year be made for a paper on one or other of the following subjects —The use of electricity in public works, hydro electric power developments, electrification of railways, electricity in agriculture, electricity in mines, long distance telephony (excluding wireless), long distance telegraphy (excluding wireless), overhead lines in rural districts, extra high voltage underground cables and their protection, Empire wireless communications The competing essays, which must be written specially for the occasion, must reach the Secretary of the Institution of Electrical Engineers, Savoy Place, W C 2, by Oct 1 next at latest

Birthdays and Research Centres.

April 14, 1867 —Prof J C McLENNAN, F R S., professor of physics and director of the Physical Laboratory, University of Toronto

In collaboration with one group of associates, I am determining the spin moments of the nuclei of several types of atoms with the object of gaining information of a definite character regarding the structure of such nuclei With another group, studies are being made of the optical and electrical properties of metals at the lowest temperatures with the object of elucidating the phenomenon of superconductivity With a third group, problems in spectroscopy are under investigation, involving not only gases but also solids and liquids I am also directing a special investigation on the heating effects produced by very short radio waves, another on the products obtainable with mixtures of certain gases subjected to irradiation by high speed electrons, and still another on auroral phenomena

April 17, 1863 —Prof GEORGE GRANT MACCURDY, curator of the anthropological collection at Yale University and director of the American School of Prehistoric Research

I am at present engaged on (1) a small volume to be called "The Coming of Man", (2) Director's Report, *Bulletin* No 7, the American School of Prehistoric Research, for 1930, (3) article on archæology and prehistory for a new encyclopædia

Societies and Academies

LONDON

Optical Society, Feb 12 —T Smith Modern optical glass as exemplified by the list of the Parsons Optical Glass Co, dated September 1926 The optical positions (μ ν) of the glass types catalogued by the Parsons Optical Glass Company and the relations between the dispersions for several segments of the visible spectrum are exhibited graphically A knowledge of the refractive indices of any glass for three wave lengths is sufficient to specify the index for the whole of the visible spectrum, and a knowledge of two indices is almost sufficient In particular, the partial dispersive ratios are almost functions (nearly linear functions) of ν only This implies that there are no glasses suitable for making apochromatic telescope objectives of large relative aperture The graphs show that the general standard of accuracy of the measured indices is high A new graphical method of interpolating refractive indices for glass is obtained —J Guild On the fixed points of a colorimetric system. The paper discusses the significance of the constants which enter into the specification of colour on the trichromatic system, and suggests certain fundamental considerations of a metrological character which ought to govern the choice of such constants in a standard reference system Various proposals which have been put forward from time to time are discussed in the light of these considerations, and the basis of the system which has been adopted at the National Physical Laboratory is explained

Royal Meteorological Society, Feb 18 —L J Sutton Note on haboobs This note is a revision and extension of a paper which appeared in the Society's *Journal* in 1925 on the severe dust storms which occur in the north and central Sudan, chiefly during the rainy seasons The statistics, which are drawn mainly from the records of Khartoum, include

frequency of occurrence, direction, diurnal variation, and average velocity Most of the haboobs appear to be due to a current of relatively cold air undercutting warm air, probably in many cases connected with the diurnal variation of temperature, which in the summer causes a depression to form during the day time over the hot arid region between Khartoum and the Nubian Desert —**S Chapman** and **Miss M Hardman** The lunar atmospheric tide at Ocean Island The lunar atmospheric tide at Ocean Island, in the Pacific, has been determined from hourly data extending, with gaps, from 1904 to 1912, or the equivalent of about five years' continuous data The annual mean semiamplitude of the tide is found to be 71 microbars, and maximum pressure occurs at about 20 minutes after lunar transit —**A C Best** Horizontal temperature differences over small distances The temperature differences over two intervals of 25 feet and 50 feet at a height of 4 feet above the ground were recorded for nearly three months It was found that during the daytime the air was not homogeneous The temperature fluctuated rapidly at any one spot, the amplitude being as much as 1 5° F under conditions of low wind velocity This non homogeneity decreased as the wind increased There is some evidence that the state of the sky also affects the amplitude of the temperature fluctuations At night the fluctuations became much slower and temperature differences up to 1 5° F persisted for periods up to 30 minutes, usually under conditions of low wind velocity The daytime periods and the night periods were usually connected by a short period of one or two hours, when the air at 4 feet was very homogeneous with regard to temperature —**E Ll Davies** A portable temperature gradient indicator The method consists essentially of measuring the differences in resistance of two platinum elements exposed at different heights above the ground The advantages and disadvantages of three types of housing for resistance elements are given in detail With the electrically aspirated housing a good galvanometer (sensitivity about 2 mm of scale per microampere), differences of temperature to within 0 1° F are measurable

Physical Society, Feb 20 — **G G Sherratt** and **J H Awberry** On the velocity of sound waves in a tube The apparent velocity of sound in a tube of diameter 2 cm has been measured at temperatures up to 400° C and with frequencies of from 3000 to 14,000 ~ The reduction in velocity below the free air value is discussed, and the suggestion is put forward that this reduction, for a single tube and gas, depends on the wave-length rather than on the frequency The theoretical expression found by Helmholtz and Kirchhoff for the reduction in velocity does not appear to be valid The method used by Dixon and by Partington and Shilling for correcting for the influence of the tube receives support —**P S H Henry** The tube effect in sound-velocity measurements The modifications in Kirchhoff's formula required to take account of the finite thermal conductivity of the tube, slip between the gas and the walls, temperature discontinuity between the gas and the walls, and absorption of energy by the walls are calculated and found to be negligible The effect of roughness of the walls is discussed, and the conclusion is drawn that the large tube-effects often found in practice are due to irregular motion of the gas —**W A Wood** A note on the elimination of the β wave length from the characteristic radiation of iron The method is based upon the selective absorption produced by a thin film of pure manganese which is obtained in the required form by electro deposition upon aluminium foil

Geological Society, Mar 4 —**W A Macfadyen** The geology of British Somaliland Some 100,000 square kilometres were mapped geologically for the first time, on the scale of 1 250,000 The larger part consists of a great plateau sloping very gently to the south-south east, fronted by a relatively low lying area of broken surface features and faulted strata Terrace gravels occur up to an altitude of 594 metres near Dagah Shabell, where they are best developed, and the river system of that district is a fine example of superimposed drainage Raised beaches are found in the Berbera district at levels of 8 metres, about 85 metres, and 200 metres, none is earlier than Pleistocene In the coast district particularly south of Bulhar and along the Jibuti border in the west, are basalts and lavas, with the dissected volcano of Elmis, all are probably of Pliocene age and later The fragmentary Dubar Series, approximately of Burdigalian age, is restricted to the coastal district The Daban Series, 2300 metres thick and resting conformably on the gypsum, occurs locally in the Guban country The south eastern half of the country is covered by Eocene strata Over the eastern part of the plateau outcrop the richly fossiliferous Middle Eocene limestones and marls 230 metres thick The Eocene rests on Cretaceous Nubian Sandstone, up to about 200 metres thick in parts of the Guban, where it includes the Shabell Beds, 830 metres of grits and red clays Jurassic strata in faulted outcrops occur only north of the plateau, except in the north east A measured section 910 metres thick, showing the complete developments near Bihendula, is found from the ammonite fauna to be mainly of Kimmeridgian age, only the uppermost 150 metres is later, while the basal 80 metres is earlier

Mineralogical Society, Mar 17 —**A J P Martin** On a new method of detecting pyro electricity On changing the temperature of certain crystals, electric poles of opposite sign are developed at the two ends In these experiments the temperature change is produced by cooling in liquid air and the electric charge is detected in the following way The crystal is suspended by a long thin glass fibre near to the copper plate, which may be moved near to, or away from, the crystal, both of them being immersed in the liquid air The charge on the crystal induces an equal and opposite charge on the plate, and the attraction between the two, causes the crystal to move nearer the plate This method is specially suited to very small crystals or to those which are decomposed on heating —**D R Grantham** and **F Oates** On the Mbosi meteoric iron, Tanganyika Territory A wedge shaped mass of meteoric iron measuring 10 ft × 4 ft × 3 ft and estimated to weigh 12 15 tons was found late in 1930 near Mbosi, between Lakes Tanganyika and Nyasa It is a medium octahedrite containing 8 69 per cent of nickel —**S R Nockolds** On the Dhoon (Isle of Man) granite a study of contamination The Dhoon granite forms a small boss-like mass intruded into the Lonan Flags Two main types are present, one of which is slightly earlier in date than the other The difference between the two types is mainly textural The main type may be termed biotite granodiorite porphyry, whilst the other is a biotite granodiorite Both types are abnormal in that the biotite occurs in clots and in association with zoisite, ilmenite (usually with a border of granular sphene), sphene itself, and, more rarely, epidote, clinozoisite, and garnet These clots represent the last remnants of a regionally metamorphosed basic igneous rock which has been absorbed by the original granitic magma It is concluded that the original magma was of alkali-granite type and similar to the

quartz porphyry dikes which are associated with the mass All the evidence points to an extensive inter change of oxides between the original magma and the basic igneous rock Further, it is shown that the peculiar albitisation of the felspars in the 'granite' of both types is indirectly dependent on the contamination —**A G MacGregor** On clouded felspars as a result of thermal metamorphism A special type of cloudiness in plagioclase due to the development of minute inclusions is shown to be the result of contact thermal metamorphism acting after con solidation of the igneous rock The effects have been observed in various contact metamorphosed lavas in Scotland Similar cloudiness is observed in the Scourie Dyke, the 'hyperites' of Sweden, malchite of Melibocus, and many other rocks The possibility of similar clouding being produced as a deuteric effect at a late stage in consolidation is considered —**C N Fenner** On the residual liquids of crystallising magmas Discussion of the character of the residues left by the crystallisation of magmas A short summary is given of outstanding points of evidence that should be taken into consideration in forming an opinion on the broad problems of differentiation

EDINBURGH

Royal Society, Feb 2 —**Sir E Sharpey Schafer** Observations on the relative rate growth of the nails of the right and left hands, on seasonal variations in the rate, and on the influence of cutaneous nerves upon it The rate of growth of the finger nails was faster in summer than in winter, and faster on the right hand than on the left A notable exception was presented by the thumb nails, which grew faster on the left hand than on the right, both in summer and winter The slowest rate of growth occurred in the nail of the little finger of the left side The cutaneous nerves of this finger had been severed and, with the exception of those which subserve pain, had not shown any functional recovery It is therefore possible that a trophic influence is exercised through the cutaneous nerves upon the growth of the nail, the possibility being supported by the fact that the little finger nail on the left or denervated side not only exhibited a slower rate of growth, but also is distinguished from the corresponding nail on the normal side in being more flattened in form, rougher on the surface, and more brittle in texture —**F J W Whipple** A note on the secular changes of rock temperature on the Calton Hill The temperature of the rock forming the Calton Hill at Edinburgh has been studied since 1837 The long series of observations was analysed recently by Mr R W Wrigley, who concluded that the fluctuations which he had discovered had their origin in the interior of the earth, and sought to correlate them with irregularities in the earth's rotation There are difficulties in accepting this interpretation of the observations It is maintained that the fluctuations of temperature are probably propagated downwards from the surface A possible explanation is that there was less sunshine at Edinburgh in the latter half of the nineteenth century than in recent years There are, however, no comparable sunshine records by which this hypothesis can be tested

PARIS

Academy of Sciences, Feb 23 —**Ch Fabry** and **H Buisson** The absorption of radiations in the lower atmosphere and the estimation of ozone From measurements of the optical density of the lower atmosphere the proportion of ozone by volume is deduced to be $2\ 2\times10^{-8}$ The higher atmosphere is much richer in ozone —**Louis Roy** The comparison of the effects of diffraction in reflecting and refracting telescopes —**V Lalan** Contribution to the study of the curve of pursuit —**Paul Delens** The congruences of curves —**Georges Giraud** Certain problems concerning systems of equations of the elliptic type —**Georges Durand** and **Gaston Rabaté** Two conceptions of the limit ensemble and an infinite collection of point ensembles —**Georges Valiron** Remarks on the theorem of Borel in the theory of meromorph functions —**J Haag** The realisation of mechanisms of pure rolling Remarks on a recent paper by F E Myard —**d'Ocagne** Remarks on the preceding paper —**R Tremblot** The study of gaseous currents by means of interference —**Ch Volet** The application of the method of least squares to the calculation of the orbits of double stars —**L Dubar** The influence of the thermal treatment on the characteristics of copper oxide rectifiers When the current is in the direction copper to oxide, it is little affected by thermal treatment, but in the reverse direction, oxide to copper, thermal treatment produces large variations in the current In the case given, the current can be varied from 0 05 ampere to 10 amperes under the same voltage, according to the thermal treatment —**P Fourmarier** The existence of an abnormal magnetic flux Critical discussion of the views of W Mitkevich the author considers that the experiments of Mitkevich are insufficient to establish the existence of a normal magnetic flux —**R de Mallemann** and **P Gabiano** The variation of the specific magnetic rotatory power in the passage from the liquid state to the gaseous state The variation of the magnetic rotatory power in the change of state may be calculated with a good approximation starting from the factor $\phi(n)=\left(\frac{n^2+2}{3}\right)$ of Lorentz any other factor, such as that of Gladstone, is markedly out of agreement with experiment —**G Bruhat** The absorption of aqueous solutions of tartaric acid The author's experimental results, and the later figures of Lucas and Schwob, are in contradiction with the classical hypothesis of the existence in solutions of two different forms of tartaric acid —**G Reboul** and **J Sambussy** The passage of the continuous (electric) current in acetone A description of experiments carried out with the view of finding out the cause of the contradictory results obtained by H Garrigue and by P Lafond The difference was traced to the effect of light on the acetone —**M Battegay** and **L Denivelle** The aryl chlorosulphinates and the aryl sulphites By the interaction of sodium phenate and thionyl chloride, in addition to phenyl sulphite, the chloride C_6H_5 O SOCl has been isolated —**Paul Lemoine** The geological and hydrogeological results of a boring at the National Natural History Museum —**Jean Lacoste** Tectonic observations on the southern Riff (Moulay Bou Chta region) —**Mme Mara Lechtova-Trnka** The presence of an ascomycete in a tubercle of *Astragalus alopecuroides* The name *Ascorhiza Leguminosarum* is suggested for this mould, which appears to be new It has been found in the tubercles of three other Leguminosæ —**Pierre Dangeard** The sensibility of *Laminaria* to external actions and iodovolatilisation —**G Nicolas** and **Mlle Aggéry** A new example of the important rôle of bacteria in phytopathology —**Emile Saillard** The fixity of composition of plants, according to Liebig, and the sugar beet produced by selection The quantity of mineral bases contained in the entire plant per 100 kgm of sugar in the root, or per 100 kgm of dry material, is not constant, it diminishes as the richness of the roots in sugar increases The sugar beet, produced by selection, has not the fixity of composition indicated by Liebig —**Jean Roy** The existence of parthenogenesis in a species of Copepod

Elaphoidella bidens —**Georges Morin and Jean Boucomont** Modifications of chronaxy in experimental rickets of the rat —**Louis Lapicque** Remarks on the preceding communication —**G Ramon, R Legroux, and M Schoen** The dissociation of the diphtheric anatoxin antitoxin complex and the recuperation of the anatoxin —**A Demolon and G Barbier** Fermentations in a heterogeneous and discontinuous medium The medium was brick clay or a quartz sand moistened with a suitable nutritive liquid, the organisms, yeast, *B coli*, and a mobile urobacillus The phenomena of diffusion and migration take place in quartz sand when there is 6-8 per cent of water present, but this is not the case with a siliceous clay medium —**H Jacotot** Researches on vaccination against bovine plague the preparation of the antigen by dehydration of the virulent splenic pulp

Official Publications Received

BRITISH

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1349 (Ae 481 -Ae Techl 519) On rendering Airflow visible by means of Hot Wires By H C H Townend Pp 5+4 plates (London H M Stationery Office) 9d net

Indian Central Cotton Committee Technological Laboratory Technological Bulletin, Series B, No 12 A Study of Comparative Results for Lea Single Thread and Ballistic Tests on Yarns from Standard Indian Cottons. By Dr A James Turner and V Venkataraman Pp ii+27 8 annas Technological Bulletin, Series B No 18 The Determination and Variation of Twist in Ring Spun Cotton Yarns By D F Kapadia and Dr A. James Turner Pp iv+25 8 annas (Bombay)

Report of the Rugby School Natural History Society for the Year 1930 (Sixty fourth Issue) Pp 48+2 plates (Rugby)

Empire Fibres for Marine Cordage African Sisal New Zealand Hemp and Indian Sunn Report of Investigations conducted by the Imperial Institute Pp 84 (London John Murray) 1s

Silvicultural Research Manual for Use in India Vol 1 General (The Experimental Manual) By H G Champion Pp xii+181+25 plates (Calcutta Government of India Central Publication Branch) 8 2 rupees 18s 9d

Department of Scientific and Industrial Research Building Research Abstracts Vol 4 (New Series) No 2 February Abstracts Nos 215 306 Pp 39 69 (London H M Stationery Office) 9d net

Transactions of the Mining and Geological Institute of India Vol 25, Part 3 December 1930 Pp 185 305+plates 4 19 (Calcutta) 4 rupees

The Research Scheme of the Institute of Brewing 1931 Pp 19 (London)

University of Leeds Clothworkers Department Report of the Work done under the Research Scheme established in 1928 with the aid of a Special Grant from the Worshipful Company of Clothworkers, Session 1929-30 Pp 18+2 plates (Leeds)

Wool Industries Research Association Report of the Council, 1930–81 Pp 34 (Leeds)

Ministry of Health Ninth Report of the Advisory Committee on the Welfare of the Blind to the Minister of Health 1930 Pp 24 (London H M Stationery Office) 6d net

Proceedings of the Royal Society of Edinburgh Session 1930 1931 Vol 51, Part 1, No 1 On the Pregnancy Rate in the Lactating Mouse and the Effect of Suckling on the Duration of Pregnancy By I Mirskaia and F A E Crew Pp 7 6d Vol 51, Part 1, No 2 Observations on the Relative Rate of Growth of the Nails of the Right and Left Hands respectively on Seasonal Variations in the Rate, and on the Influence of Nerve section upon It. By Sir E Sharpey Schafer Pp 8 13. 6d (Edinburgh Robert Grant and Son London Williams and Norgate, Ltd)

FOREIGN

State of Connecticut State Geological and Natural History Survey Bulletin No 47 The Glacial Geology of Connecticut By Prof Richard Foster Flint Pp 294+64 plates (Hartford Conn) 2 dollars

The Tôhoku Mathematical Journal Vol 33, Nos 3 4, January Pp 181 365 (Sendai Tôhoku Imperial University)

R Osservatorio Astrofisico di Catania Annuario 1931 Pp iii+87 (Catania)

U S Department of Agriculture Farmers Bulletin No 1651 The Corn Earworm as an Enemy of Field Corn in the Eastern States By W J Phillips and George W Barber Pp ii+18 (Washington D C Government Printing Office) 5 cents

Occasional Papers of the California Academy of Sciences 17 Log of the Schooner *Academy* on a Voyage of Scientific Research to the Galapagos Islands 1905-1906 By Joseph R Slevin Pp 162+17 plates. (San Francisco) 3 dollars

Intâiul Congres Național al Naturaliștilor din Romania (Premier Congrès National des Naturalistes de Roumanie) ținut la Cluj dela 18 până la 21 Aprilie 1928 (tenu à Cluj du 18 au 21 avril 1928) Dare de seamă a lucrărilor publicată de (Compte rendu des séances publié par) Al Borza și (et) E Pop Pp viii+518+17 planșe (Cluj Editura (Edité par) Societatea de Științe) 30 lei

Report of the Aeronautical Research Institute Tôkyô Imperial University No 66 The International Wing Model measured in the Wind Tunnels of Japan By the Wind Tunnel Committee specially appointed by the Aeronautical Council of Japan Pp 307 440 (Tôkyô Koseikai Publishing House.) 1 03 yen

Państwowa Rada Ochrony Przyrody Nr 28 Sprawozdanie z działalności Państwowej Rady Ochrony Przyrody w roku 1930 Napisał Prof Dr Władysław Szafer Pp 19 Wydawnictwo Okręgowego Komitetu Ochrony Przyrody na Wielkopolskę i Pomorze Zeszyt 2 Pp. 60 Ochrona Przyrody Organ Państwowej Rady Ochrony Przyrody Treść rocznika 10 go Pp. iv+309+16 tab (Krakow Państwowa Rada Ochrony Przyrody)

U S Department of Commerce Coast and Geodetic Survey Serial No 498 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Vieques, P R in 1923 and 1924 By W N McFarland Pp ii+94+5 plates (Washington D C Government Printing Office) 40 cents

U S Department of Agriculture Farmers Bulletin No 1655 The Control of Moths in Upholstered Furniture By E. A Back and R T Cotton Pp ii+33 10 cents Technical Bulletin No 231 A Revision of the American Species of Empoasca known to occur North of Mexico By Dwight M DeLong Pp 60 15 cents (Washington D C Government Printing Office)

University of Illinois Engineering Experiment Station Bulletin No 215 The Column Analogy, Analysis of Elastic Arches and Frames by the General Formula for Flexure By Prof Hardy Cross Pp. 75 40 cents Bulletin No 219 Treatment of Water for Ice Manufacture, a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in cooperation with the Utilities Research Commission By Prof Dana Burks, Jr Pp 112 60 cents Bulletin No 220 Tests of a Mikado Type Locomotive equipped with Nicholson Thermic Syphons, a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois in cooperation with the Illinois Central Railroad Company and the Locomotive Firebox Company By Prof Edward C Schmidt, Prof Everett G Young and Herman J Schraeder Pp 99 55 cents (Urbana Ill)

CATALOGUES

Classified List of Second hand Scientific Instruments No 99, April Pp 58 (London C Baker)

Catalogue of Scientific Journals and Transactions of Learned Societies (Catalogue No 1) Pp 12 (London Oppenheim and Co (Rare Books) Ltd)

Diary of Societies

FRIDAY APRIL 10

ROYAL ASTRONOMICAL SOCIETY at 5 —L H Thomas A Criticism of Current Theories of Stellar Structure and a Suggestion —H Roth The Density Distribution in Capella —Dr H Jeffreys On the Cause of Oscillatory Movement in Seismograms —S F Grace Tidal Oscillations in Rotating Rectangular Basins of Uniform Depth —G Shajn On the Behaviour of Certain Simple Multiplets in Stellar Spectra

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6 Exhibits, including *Opisthoporus* and *Lymnaea stagnalis* (L).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers Club, Manchester) at 7 Dr A E Dunstan The Present Position of the Thermal Decomposition of the Lower Hydrocarbons

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 7 —H Roe and others Discussion on Aerial Ropeways

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall, Manchester) at 7 —Annual Meeting

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (Annual General Meeting) (at Mayfair Cafe Cardiff), at 7 15 —Prof W J Jones Chairman s Address

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —F Russell Difficulties in Power Transmission by Belt and how to overcome them

SATURDAY, APRIL 11

GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square W C 1) at 2 30 —Sir Richard Gregory Bart. Comets and Shooting Stars (Lecture).

MONDAY, APRIL 13

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Rev Dr D M McIntyre The Jewish Apocalyptic and its Bearing on the New Testament.

ROYAL GEOGRAPHICAL SOCIETY at 5 —P Lake Island Arcs and Mountain Building

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers) at 5 30 —Debate The Final Report of the Royal Commission on Transport.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University) at 7 Annual General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne), at 7 —Annual General Meeting

CERAMIC SOCIETY (Pottery Section) (at North Staffordshire Technical College, Stoke on Trent) at 7 30 —W Podmore Pottery Engineering —its Failures and Possible Improvements —A S W Odelberg The Durability of Bone China Hotel Ware

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —G Grey Modern Flats

ROYAL SOCIETY OF ARTS, at 8 —Dr N A V Piercy The Present Position in Aeronautics (Howard Lectures) (1).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—J W Walters Studies in the Free Air Cooling of Hot Gases in Mains —F L Bassett Some Factors affecting the Corrosion of Buried Steel

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University)—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cheltenham).—H. T. Young: Modern Lighting (Lecture).

TUESDAY, APRIL 14.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. W. E. Le Gros Clark: The Brain of *Microcebus murinus*.—M. Burton: The Interpretation of the Embryonic and Post-larval Characters of certain Tetraxonid Sponges, with Observations on Post-larval Growth stages in some Species.—Dr. R. Bigalke: Note on the Egg of the Nile Crocodile (*Crocodylus niloticus*).—D. L. Bryce: Report on the Rotifera. Mr. Omer Cooper's Investigations of the Abyssinian Freshwaters (Dr. Hugh Scott Expedition).—I. Filipjev: Report on Freshwater Nematoda. Mr. Omer Cooper's Investigation of the Abyssinian Freshwaters (Hugh Scott Expedition).—Col. A. E. Hamerton: Report on the Deaths occurring in the Society's Gardens during the Year 1930.
INSTITUTION OF CIVIL ENGINEERS, at 6.—R. W. Mountain: The 132 Kilovolt Transmission System of the Central Scotland Electricity Scheme.—C. S. Berry, H. P. Gaze, and C. E. H. Verity: The Deptford West Power Station of the London Power Company, Limited.
INSTITUTE OF MARINE ENGINEERS, at 6.—F. A. Pudney: The Caprotti Bauer Wach Marine Installation.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6.15.—L. S. Crutch: Long Distance Telephony To-day.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce, Birmingham), at 6.30.—At 7.—F. R. O'Shaughnessy: Some Modern Methods of Sewage Disposal.—Dr. H. E. Lockwood and Dr. R. S. Hayes: A New Method of Testing Agar and Gelatine Jellies.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow) (Annual General Meeting), at 7.30.—B. Leggott: The Medical and Surgical Applications of Electricity.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—W. E. Watson Baker and others: Discussion on Microscope Design with special reference to Advances since 1914.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. L. A. Willcox and J. D. Farmer: A Comparison of Refrigeration Systems.

WEDNESDAY, APRIL 15.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. J. D. Rolleston: J. B. Bouillaud (1796–1881), a Pioneer in Cardiology and Neurology.
ROYAL METEOROLOGICAL SOCIETY, at 5.—W. D. Flower: An Analysis of the Cold Front over Egypt on Mar. 7, 1929.—W. H. Pick: A Note on the Relationship between Fog and Relative Humidity.—H. Jameson: Temperature Observations on Adam's Peak, Ceylon.—*To be taken as read*.—S. P. Wiltshire: The Correlation of Weather Conditions with Outbreaks of Potato Blight.
ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—L. La Cour: Improvements in Everyday Technique in Plant Cytology.—Prof. A. G. Hornyold: On the Preparation of Eel Scales.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Prince Henry's Room, Fleet Street), at 5.30.—Col. R. E. B. Crompton: The First Installation of House to House Supply in the United Kingdom.—G. A. Orrok: The Pearl Street Station: The First Steam Power Station in America.—Prof. J. K. Finch: The Civil Engineering Achievements of John B. Jervis.
INSTITUTE OF FUEL (Annual General Meeting) (at Chemical Society), at 6.—A. Marsh: Smoke Problem: A Consideration of some of its Economic Aspects and the Difficulties of its Solution.
INSTITUTION OF CIVIL ENGINEERS (Students Meeting), at 6.30.—F. C. Ball: Some Considerations on the Economic Design of Small Reinforced Concrete Girder Bridges for Highway Use.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—D. B. Hoseason: The Cooling of Electrical Machines.
ROYAL SOCIETY OF ARTS, at 8.—D. R. Wilson: Industrial Lighting.
ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—S. Wernick: Experiments in Cadmium Plating.
SOCIETY OF GLASS TECHNOLOGY (at Sheffield).—Annual General Meeting.

THURSDAY, APRIL 16.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
CHILD-STUDY ASSOCIATION (at 90 Buckingham Palace Road), at 6.—Dr. J. N. Glaister: Does the Developing Mind Recapitulate Ancestral History?
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—R. M. Charley: Recent Progress in Large Transformers.—W. E. M. Ayres: The Application of the Induction Voltage Regulator.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. A. H. Davis: Aircraft Noise.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.
BRITISH INSTITUTE OF RADIOLOGY, at 8.30.—Dr. H. S. Souttar: The Ideal Distribution of Radon Seeds.—W. E. Schall: A Two Valve Transformer Unit for Diagnosis and Therapy.—Dr. A. Orliansky: Uniformly Impressed Reduced Prints from Contrasty Negatives.—Dr. L. A. Rowden: A Technique of Radiographic Pelvimetry.

FRIDAY, APRIL 17.

BRITISH INSTITUTE OF RADIOLOGY (at North Middlesex Hospital, Edmonton), at 11 A.M.—At 5.—Meeting of Medical Members.
ELECTRICAL ASSOCIATION FOR WOMEN (at Park Lane Hotel), at 11.30 A.M.—Annual General Meeting.—At 3.—Report from Branches, etc.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—A. J. Maddock: The Generation of Current Pulses of Rectangular Wave-form.—R. A. Fereday: An Improved Method for the Comparison of Small Magnetic Susceptibilities.—Dr. E. G. Richardson: Edge Tones.
NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (Annual General Meeting) (at Royal Society), at 5.
ROYAL SANITARY INSTITUTE (at Guildhall, Poole), at 5.—E. J. Goodacre and others: Discussion on Some Aspects of Municipal Sanitation.—Alderman J. C. Julyan and others: Discussion on Prospect and Retrospect.—Dr. G. Chesney and others: Discussion on Diphtheria Immunisation at Work.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—C. D. Gibb: Post-War Land Turbine Development.
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—J. Foster King: Corrosion of Oil Tankers.
COKE OVEN MANAGERS ASSOCIATION (Midland Section) (at Sheffield University), at 6.30.—Prof. R. V. Wheeler: Rational Analysis of Coal.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—H. E. Potts: The Patent Law relative to the Chemist and Technologist.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. W. Hill and G. F. Shotter: Current Transformer Summations.
INSTITUTE OF FUEL (East Midlands Section) (at University College, Nottingham), at 7.—H. I. Lirie: Theory and Practice of the Gasification of Coal in Producers.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Demonstration of Modern Scientific Instruments and Apparatus of Special Interest.
INSTITUTE OF METALS (Sheffield Section) (in Non-Ferrous Section of Applied Science Department, University of Sheffield), at 7.30.—R. Genders: Extrusion.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. E. Gray: The Transmission of Gas.—T. G. Martin: The Building Requirements of Lifts.
INSTITUTE OF BREWING (Yorkshire and North Eastern Section) (at Queen's Hotel, Leeds).—Annual Meeting.

PUBLIC LECTURE

TUESDAY, APRIL 14.

GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeeding Lectures on April 15, 16, and 17.)

DISCUSSION

APRIL 17 AND 18.

A GENERAL DISCUSSION ON PHOTOCHEMICAL PROCESSES.

FARADAY SOCIETY (in Department of Chemistry, Liverpool University).
Friday, April 17, at 10 A.M.—Molecular Spectra in Relation to Photochemical Change.
Introductory Paper: Prof. R. Mecke.
Ultra-violet Absorption Spectra of Acetylene and Formaldehyde: Dr. G. Herzberg.
The Absorption Spectra and the Optical Dissociation of the Hydrides of the Oxygen Group: C. F. Goodeve and N. O. Stein.
The Photochemical Properties of the Carbonyl Group: F. W. Kirkbride and R. G. W. Norrish.
Friday, April 17, at 2.30.—Photochemical Kinetics in Gaseous Systems.
Introductory Paper: Prof. M. Bodenstein.
The Reaction between H_2 and O_2 under the Influence of Photochemically produced H Atoms. The Relation of its Mechanism with that of the Explosive Gas Reaction at High Temperatures: Dr. W. Frankenburger.
The Photochemical Union of Hydrogen and Chlorine at Low Pressures: J. B. Bateman and H. C. Craggs.
The Photosensitised Decomposition of Nitrogen Trichloride by Chlorine, and the Induction Period of the Hydrogen Chlorine Reaction: J. G. A. Griffiths and R. G. W. Norrish.
The Photosensitised Formation of Hydrogen Peroxide in the System Hydrogen-Oxygen-Chlorine: R. G. W. Norrish.
The Photochemistry of Mixtures of Chlorine, Oxygen and Carbon Monoxide: Prof. G. K. Rollefson.
The Mechanism of the Photo-Oxidation of Gaseous Alkyl Halides: J. R. Bates and R. Spence.
A Comparison of the Efficiency of Photochemical Reactions and Similar Reactions Produced by Gaseous Ions: G. R. Gedye.
Saturday, April 18, at 10 A.M.—Photochemical Change in Liquid and Solid Systems.
Introductory Paper: Prof. A. Berthoud.
The Photochemical Temperature Coefficient: D. W. G. Style.
The Acceleration of the Electrolytic Deposition of Hydrogen and Oxygen by Light of Short Wave Length: Dr. F. P. Bowden.
The Photochemical Decomposition of Chlorine Dioxide in Carbon Tetrachloride Solution: Y. Nagai and C. F. Goodeve.
The Photochemical Oxidation of Potassium Oxalate by Iodine in Aqueous Solution: Prof. A. J. Allmand and K. W. Young.
A Comparative Study of the Photographic Process under Different Experimental Conditions: Prof. J. Eggert.
The Latent Photographic Image: New Methods of Investigation and Results: Prof. F. Weigert.
Sensitisations of the First and Second Type: Prof. F. Weigert.
Saturday, April 18, at 2.30.—Photosynthesis.
Introductory Paper: Prof. E. C. C. Baly.
The Application of the Einstein Law to Photochemical Processes in Living Cells: Prof. O. Warburg.
The Measurement of the Physiologically Active (Erytheme forming) Ultra-Violet by means of the Photochemical Formation of Dyestuffs from the Leuco-Compounds of Triphenyl Methane Dyes: Edith Weyde and W. Frankenburger.

SATURDAY, APRIL 18, 1931

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Scientific Medicine

MUCH of the more important subject matter of the annual report of the Medical Research Council recently published, and dealt with elsewhere in this issue (p 598), was brought to public notice by the newspapers as occasion arose The establishment at University College Hospital of a department of clinical research is an example Scientific results achieved or foreshadowed during the year under review were many and valuable, and to be able to say of such a year that it "illustrates the general features that have marked the progress of modern medical investigation throughout the world during the present generation" is an indication of solid attainment Nevertheless, there are two sides to progress —progress in discovery and progress in organisation , and the phrase quoted is strictly relevant to an argument concerning the machine and its design rather than its output

This argument, unobtrusive but intense, affords an answer to professional criticism, which, having filled out its voice in the correspondence columns of the *Times*, died away again last summer, its 'airy swellings', unlike the music in 'Endymion", unrevived They will be revived sooner or later, for the sufficient reason that "the study of disease as such is by no means the only field of medical research it is a field indeed that work in all the other fields is actually aimed at reducing" For the time being, the Medical Research Council resolves this dualism within its own organisation but it cannot resolve it elsewhere It holds a balance between the claims of investigations which lead at best to results of professional and technological value and the claims of what the authors of the report call the "intensive pursuit of the more primary studies" that serve medical science

Fortunately from an evidential point of view, unfortunately otherwise, what sort and standard of investigation is deemed specially desirable by the Council's critics is revealed by the plans in existence for a research laboratory in the grounds of Charles Darwin's house, where young men waiting for hospital appointments are to wait less unprofitably than they wait now Since a feather would turn the Council's scale in favour of applications, and since the existence of a laboratory for experimental surgery might as easily increase as diminish the clamour for a more professional outlook, it is not to be counted altogether a gain that the poise within the Council itself is so delicately adjusted

Work accumulates faster than funds Increasing responsibilities are laid upon the Council by the growth of work within the range of the Therapeutic Substances Act "This growing burden depends in part upon the advisory relations of the Council to the routine administration of the Act For the rest, it consists in the active promotion of research work concerned with the preparation and use of standards of reference for the proper assay of biological substances" It is urged that such work for the protection and assistance both of the public and of the medical profession is valuable Of course it is, and so is the part played by the League of Nations in gaining international adherence to common standards It is urged that the Council is charged by Parliament with the duty of aiding 'from a narrowly limited fund whatever, being needy, is most fruitful and most hopeful" either in applications or in fundamentals, and that this duty is onerous Of course it is It is urged that the curative work of the physician or surgeon is vitally important but is not the sole concern of medicine, which increasingly, step by step as knowledge advances, is concerned "with the sciences and arts of preventive work in all its kinds" "The science of nutrition, newly born almost within this generation, is bringing into sight new possibilities of greatly augmenting the preventive services of medicine and of setting in the middle of the picture not so much the attack upon declared disease as the establishment of right development and full health" The management of life, in industry and in the home, replaces the control of active disease

It is harder to delimit the boundaries to be set to medical research than to describe its major concerns The Council gives up the attempt, falling back upon the words of the Ormsby-Gore Research Co ordination Sub Committee "Medical research deals by no means only with the cure of disease It deals with the proper development and the right use of the human body in all conditions of activity and environment as well as with its protection from disease and accident and its repair"

Scientific medicine is no longer preoccupied by disease, which was "the earliest preoccupation of medicine" Yet the report asks us to "think of it" as being still so preoccupied, in order that we may appreciate the dependence of the modern clinical worker "more and more upon the tools and methods of the laboratory" Problems are taken from the bedside to the laboratory for their solution and there new problems are distilled for exploitation in the clinic Was Emerson the origin of this compensatory theme? "It is thus written, because it is thus in life Our action is overmastered, and characterised above our will by the law of nature We aim at a petty end quite aside from the public good, but our act arranges itself by irresistible magnetism in a line with the poles of the world" At all events, Emerson was equal to the theme to the end If "an inevitable dualism bisect nature", compensation lurks "the man or woman who would have remained a sunny garden flower, with no room for its roots and too much sunshine for its head, by the falling of the walls and the neglect of the gardener, is made the banian of the forest, yielding shade and fruit to wide neighbourhoods of men"

It is to be hoped that the compensatory ingenuity of the Medical Research Council will equal the transcendentalist's in compassing the termination of its theme when the time comes But that is not yet "By far the greater part of the work the Council aid or initiate is done within the Universities or in Hospitals serving Universities In this way the work gains not only from the intellectual freedom that belongs to University life and the opportunities that it brings of stimulating and recruiting youth, but it gains also by the use of material resources derived from other funds, both public and private, ancient and recent, without which not one half of the work now to be described could have been sustained" The weights are indeed exquisitely poised It is, however, a wholesome reminder of realities to turn back a page or two to the confession that the contrasted (not compensatory in this case) tendencies of modern medicine, the extensive and the intensive, must each "bring its own difficulties" Nevertheless, it cannot be said that these have been obscured for readers familiar with them

The Council, it seems, is marking time It has arrived, as it were, at a definite stage in the race, the egg still in the spoon Hints of future policy are scarcely discernible A year ago there was some expectation of a policy of centralisation It is not suggested in these pages Praise of the universities is mere 'thank you', and gratitude is not always a vivid sense of benefits to come Clinical research is policy active, and assay of biological substance an obligation Policy waits on politics and the exchequer whether England will prefer to receive modernisation at the hands of M André Siegfried or Sir Oswald Mosley or will prefer not to receive it at all It is all very well for Germans to remember "as an object-lesson of the conception of the State's functions,

that Prussia founded the University of Berlin in the days of her deepest political depression ", in the words of General von Seeckt Germany is not England, but a country that believes in what it calls "geistige Macht" Abraham Flexner ("Universities, American, English and German") may be right, and "To be frank, despite their great scholars and scientists and ours this sort of thing does not come easy to either Great Britain or America"

Flexner, an acute, if strongly individualised observer of the state of scientific organisation the world over, has it on the same page "The creation of the University Grants Committee, the Medical Research Council, the Department of Scientific and Industrial Research indicates recognition of the fact that England lacks modern universities The organisations just named give temporary relief—a block grant, support for a promising investigator or an important investigation Such agencies are not superfluous, under all circumstances they have their uses, but they are no substitute for universities, amply endowed, amply equipped, and amply attended by a sufficient group of men and women dedicated to the search for truth They seem to say 'We lack developed universities While we are waiting for them or in preparation for them, let us train this or that promising man, let us get this or that thing done' It is all very well, but it does not answer" He calls the Medical Research Council "the one mitigating factor of importance" in Britain's unorganised and undeveloped resources in scientific medicine, and in this report we have the measure of its mitigation

Egyptian Mathematics

Mathematischer Papyrus des Staatlichen Museums der Schönen Künste in Moskau Herausgegeben und kommentiert von W W Struve Unter Benutzung einer hieroglyphischen Transkription von B A Turajeff (Quellen und Studien zur Geschichte der Mathematik, Abteilung A Quellen) Pp xii + 198 + 10 Tafeln (Berlin Julius Springer, 1930) 48 80 gold marks

THIS edition of the Moscow papyrus (complete with plates giving photographs of the whole of the text and a hieroglyphic transcription) has been eagerly awaited by Egyptologists and historians of mathematics alike The volume is finely produced, and we can only congratulate the author upon the result of some three years' intensive study of the papyrus and all the literature of the subject of Egyptian mathematics Egyptologists will in due course have much to say upon it, the present notice will deal with it from the point of view of the mathematician only

The papyrus, now in the Museum of Fine Arts at Moscow, formerly belonged to Vladimir Golenischchev, who bought it in Egypt in 1892–93 or 1893–94 It is said to have come from the necropolis of Dra Abū'l Negga, in the immediate neighbourhood of the place where the Rhind papyrus was found, namely, in the ruins of one of the small buildings near the Ramesseum Written during the Thirteenth Dynasty, it was copied from an original of the middle of the Twelfth Dynasty, slightly earlier, if anything, than the original of the Rhind

We have known something of the content of the papyrus since Turaiev published in *Ancient Egypt*, 1917, a paper on "The Volume of the Truncated Pyramid in Egyptian Mathematics" (problem No 14 in Struve's numbering) A further paper by Zinzerling published in 1925 contained the translation and transcription by Turaiev of four more problems from the papyrus, three of which are geometrical These three problems, together with that of the truncated pyramid, are the subject of a long and important article by Battiscombe Gunn and T Eric Peet in the *Journal of Egyptian Archæology* (vol 15, 1929, pp 167 185) As compared with the Rhind papyrus, the Golenischchev papyrus shows certain differences Whereas the Rhind, although severely practical (there is only one hint in it of a general formula), has its problems arranged in distinct groups and is apparently a kind of handbook of instruction, the Moscow papyrus, where the problems are arranged anyhow, is more like an examination paper (with solutions), the suggestion of the editor is that it was in use, in a school for scribes, as a kind of test paper The problem is given to the pupil by the scribe teacher, "If thou art asked do so and so", the working is supposed to be shown by the pupil to the teacher, sometimes with the word "See!" added, and the teacher replies, "Thou hast found it correctly' The concrete numbers chosen for illustration are as simple as possible, so that there is none of the complicated arithmetical work which we find in the Rhind

The problems (twenty five in number) are re-arranged by the editor in groups (1) 'cooking ratio' problems relating to the interchange of loaves and measures of beer according to the 'strength' of each, (2) simple rule of three problems, (3) 'hau' calculations corresponding to equations in one unknown, (4) problems of finding areas and volumes We have also in the papyrus the operations of

squaring and finding the square root, which do not appear in the Rhind A typical problem is to find the sides of a rectangle (or a right angled triangle which is the half of a rectangle), when the area and the ratio of the sides are given This leads to the equivalent of an equation of the form $(m/n)x^2 = A$ m/n is, of course, expressed as the sum of submultiples, for example, $\frac{1}{2} + \frac{1}{4}$ In one case $m/n = \frac{1}{2} + \frac{1}{4}$ and A is 12 The Egyptian says, "Reckon with $\frac{1}{2} + \frac{1}{4}$ to find 1 (that is, he divides 1 by $\frac{1}{2} + \frac{1}{4}$ or $\frac{3}{4}$) result $1\frac{1}{3}$" He then multiplies 12 by $1\frac{1}{3}$, making 16, and extracts the square root of 16 result 4 Thus the side we have called x is 4, and the other side is $(\frac{1}{2} + \frac{1}{4})$ 4 or 3

Of outstanding interest is the problem No 14, which, as indicated above, gives the correct com putation of the content of a frustum of a pyramid with square base, cut off by a plane parallel to the base (in the particular case the side of the square base is 4, the side of the opposite face 2, and the height 6) In accordance with the correct formula $\frac{1}{3}h(a^2 + ab + b^2)$, where h is the height and a, b the sides of the square base and top respectively, the Egyptian says, in short, "Square 4 (the side of the base), result 16 Double 4 (that is, multiply the 4 by 2, the side of the upper square) result 8 Square 2 result 4 Add $16 + 8 + 4 = 28$ take $\frac{1}{3}$ of 6 (the height), that is 2 reckon with 28 twice (that is, multiply the 28 by the 2) See! we have 56 Thou hast reckoned correctly" How came the Egyptian by the correct formula? The question is discussed at length by Gunn and Peet in the paper referred to, and we may expect it to give rise to much further speculation The formula can be obtained by algebra (or its equivalent in the shape of mensuration) in two ways (1) by regarding the frustum as the difference between two similar pyramids with square bases, (2) by drawing perpendiculars to the base from the four corners of the square top and so splitting up the figure into (a) a right parallelepiped with base a^2 and height h, (b) four prisms, each of which has for one face one of the erect faces of the parallelepiped, and (c) four small pyramids at the corners, with square bases, each of which has $\frac{1}{2}(a - b)$ for its side The second method is, *mutatis mutandis*, that of Heron's "Metrica", II 8, and the first that of II 7 In either case we must know the formula $\frac{1}{3}a^2h$ for the volume of a pyramid with base a^2 and height h The equivalent of this is obtained by Euclid in Props 5 7 of Book XII by the method of exhaustion, the ancient substitute for the calculus It is not conceivable that the Egyptians had attained to this order of ideas. On the other hand, for the purpose of constructing their pyramids, they had the greatest practical interest in knowing the amount of material that would be required for a pyramid of given dimensions Actual experience would in time give a rough guide, and they could easily arrive at an expression for the content of a pyramid by measuring how much corn, or what not, would go into a vessel of that shape, for they must have seen that the height and the area of the base would come into the calculation Struve agrees that the Egyptians must have arrived at the formula for the complete pyramid in some such practical way, the rest of the calculation for the frustum would offer no insuperable difficulty

The Egyptian achievement is the more remarkable when compared with other ancient attempts to solve the problem A primitive mathematician would naturally think of multiplying the height by some mean area, the formula thus obtained might be $\frac{1}{2}(a^2 + b^2)h$ or $\{\frac{1}{2}(a + b)\}^2h$ The former approximation is found in the "Stereometrica" attributed to Heron, it is parallel to, and may have been suggested by, a similar formula for the volume of a frustum of a cone used by the Babylonians about 2000 B C The second is found in Brahmagupta, as well as in the "Stereometrica" Improving on these cases, Kurt Vogel has recently suggested in the *Journal of Egyptian Archæology* that the Egyptian may have thought of multiplying the height by the average of *three* areas, a^2, ab, and b^2, that is, $\frac{1}{3}(a^2 + ab + b^2)$ but it seems in the highest degree unlikely that this would occur to anyone who did not know the formula beforehand

Space does not allow us to discuss the other remarkable problem (No 10), where, if the interpretation is right, and assuming the known Egyptian estimate of the value of π, namely, $\frac{256}{81}$, the author seems to calculate correctly the surface of a hemisphere, whereas, so far as we know, Archimedes was the first person to prove scientifically that the area of the surface of a sphere is equal to four times the area of a great circle in it

An important result incidentally obtained by Struve relates to the once disputed question whether certain triangles in problems 51 and 52 of the Rhind papyrus are right angled or isosceles He shows from the problems in the Moscow papyrus that in the case of the right-angled triangle the perpendicular sides are called by names which mean 'length' and 'breadth' as in a rectangle, whereas in problem 4, which is identical with No 51 of the Rhind, the area of the triangle is obtained as the product of the 'tp r' and the 'mryt', the

same terms as those used in the Rhind The triangles in the Rhind are therefore not right-angled, and Struve concludes, like Peet and Gunn, that they are isosceles, like them, too, he arrives (though by a slightly different route) at the conclusion that, while 'tp-r' means the 'base', 'mryt' can only be the perpendicular height (as it must be if the formula used is correct), and not one of the sides other than the base T L H

Physical Chemistry applied to Biology

(1) *Colloid Science applied to Biology a General Discussion held by the Faraday Society, September–October, 1930* Pp 659 865 (London The Faraday Society, 1931) 12s 6d

(2) *Precis de chimie physique à l'usage des etudiants en médecine* Par Prof Fred Vlès Pp vii+414 (Paris Vigot frères, 1929) 50 francs

(1) THE Report of the Faraday Society's General Discussion at Cambridge on "Colloid Science applied to Biology" is a substantial volume, containing more than 200 pages The twelve papers which were presented to the meeting only occupy about 120 pages, so that the discussion is responsible for the other 80 pages This is an accurate reflection of the fact that a lively discussion was maintained during a series of sessions covering two complete days, of which only a small part was occupied by the presentation of papers which had already been circulated in advance The keenness of the discussion, and the large number of eminent research workers who took part in it, provided a remarkable vindication of the recently adopted policy of the Faraday Society in undertaking the organisation of a discussion on colloid science in alternate years, but it also demonstrated, in an even more emphatic way, the value and importance of a meeting at which biologists on one hand and chemists and physicists on the other hand could meet on neutral ground to discuss problems for the solution of which co-operative effort from both sides is obviously needed

The widespread belief that the study of living matter may in the near future lead to even greater advances than those which have resulted during the past twenty years from the study of atomic structure, emphasises the urgency of this co-operation, and indicates the liberality of the crop that is waiting to be harvested From this point of view special interest is attached to the 'introductory remarks' on "The Structure of Living Matter", by Sir F Gowland Hopkins, and to the 'conclusion' of Sir William Hardy, neither of which has hitherto appeared in print The former directs attention to the almost absolute neglect of colloid science in the decade 1887–97, and the awakening of activity which followed the appearance of Hardy's papers in 1899 and 1900, but it also includes a warning that the problems presented by living systems are very complex, and that it is essential to keep in touch with the reality that is inherent in that complexity, since artificial colloidal systems do not and cannot "display, save in some accidental and unreal aspects (of which the importance is often exaggerated), the attributes of life" Sir William Hardy also urges that "at the present moment biology is overcharged with facts", and points out the "prodigious services" which could be rendered by a mathematical physicist who had sufficient courage to "leave his home in the physical laboratory" and "come over the way" to "live with biologists under the same roof"

If the Faraday Society had done nothing more than provide a platform from which the urgency of this call could be announced, the organisation of the meeting and the publication of the present report would have been sufficiently justified, the fact that the meeting was held in Cambridge may, perhaps, be interpreted as in some sense a challenge to the University to undertake the leadership in a new period of advance in natural knowledge

(2) The modest volume of Prof Vlès is at the same time an introduction to physical chemistry and a store of information as to its applications to biological problems It could only have been written by a physical chemist who had taken up his abode in a biological environment and thus acquired an interest in and an insight into the bewildering problems of living matter From this point of view, the fact that Dr Vlès has been attached for some years to the faculty of medicine in the University of Strasbourg, instead of holding a general chair of physical chemistry, provides a sufficient explanation of the fact that the biological aspects of the subject really dominate the whole book, instead of being mere addenda to serve as a 'bait' to entrap the interest of the medical student, or 'sugar and spice' to tickle his palate when engaged in the compulsory study of an unpalatable subject The sympathetic introduction written by the dean of the Faculty of Medicine is more than justified by the whole heartedness with which Prof Vlès has devoted himself to his task

The book itself is divided into three parts, dealing mainly with osmosis and related properties of solutions, electrical properties of solutions, and the colloidal state, but there are two appendices, one

dealing with interfacial charges and the stability of suspensions and the other with the physical chemistry of bacteria and of the fluids of the body The second appendix covers more than fifty pages and represents a course of lectures which has been delivered annually to the Faculty of Science during the past ten years It is of a different character from the earlier sections of the book, where the primary object is to give instruction in physical chemistry, since its main purpose is to describe the advances in knowledge which have been made as the result of the application of physico chemical methods of investigation to biological problems Those who heard the recent Croonian Lecture will be interested to note the references made to the work and theory of Bordet on toxins and anti toxins, but there is also a number of references to the author s own experimental observations

The book is issued in a cheap and unpretentious form Its importance depends not merely on the immediate value of the material which it contains, but also on the evidence which it affords of a growing collaboration between physicist and biologist in the difficult but fertile study of living matter

Index Londinensis

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies, being an emended and enlarged edition continued up to the end of the Year 1920 of Pritzel s Alphabetical Register of Representations of Flowering Plants and Ferns compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew, by O Stapf Vol 3 Pp iv + 555 Vol 4 Pp iv + 568 Vol 5 Pp iv + 549 (Oxford Clarendon Press, London Oxford University Press 1930–1931) £5 5*s* net each vol

VOLUME 3 of this work appeared in June 1929 It contains 555 pages and references to illustrations of all plants from *Earina* to *Justicia* inclusive Volume 4 was published in October 1930 It consists of 568 pages and references to plants from *Kadsura* to *Pedicellia* inclusive Volume 5 appeared in February 1931 In its 549 pages are to be found references to illustrations from *Pedicularis* to *Sapium* inclusive Thus, such important genera as *Pelargonium*, *Pinus*, *Pirus*, *Primula*, *Rhododendron*, and *Rosa* are included As exemplifying how the same species may occur under different generic names in different parts of the "Index", *Pelargonium pallens*, *P parviflorum*, *P zonale*, and others are found under *Geranium* in Vol 3, *Prunus Padus* occurs as *Cerasus Padus* and *Potamogeton palustris* as *Comarum palustre* in Vol 2, *Rhododendron indicum* as *Azalea indica* in Vol 1, and so on Names are always quoted just as the author gives them from whose work the references are taken, and this necessarily involves the quotation of references to the same species in different volumes

Sound orthography and grammatical correctness and consistency, though matters of minor importance, should not be conspicuous by their absence in a work of this nature, and the "Index", on the whole, sets a good example in this respect It will be noted that tree names ending in *us* which have come down from the old classical writers, such as *Quercus*, *Pinus*, *Rhus*, *Sambucus*, are of feminine gender, while those of recent origin, such as *Phyllanthus*, *Podocarpus*, *Pterocarpus*, are masculine Again, the more correct spellings "*Pirola*" and "*Pirus*" are used in preference to "*Pyrola*" and "*Pyrus*" so commonly in vogue *Ranunculus acer*" is the name adopted for the common buttercup rather than the ungrammatical "*R acris*" used by Linnæus, and this seems quite logical, but in the case of *R palustris*, the form *paluster*" would have been more consistently correct The fact that some rather obscure classical authors, like Ennius and Columella, have used the forms "*acris*" and "*palustris*" for the masculine gender, cannot alter the matter

A few of the features of the "Index" may be referred to here In accordance with the most recent views, many of the old comprehensive genera have been broken up, so that, for example, in the case of the grass *Festuca*, there are now 25 recognised genera which formerly were all included in this genus These are all arranged alphabetically and numbered in sequence after the heading "*Festuca* Auct ", and to each species cited under it a number is attached indicating to which genus it properly belongs, thus, *F duriuscula* is a true *Festuca* as understood by Linnæus, but *F inermis* is a *Bromus* On the other hand, there are other genera, such as *Bucetum* and *Gouinia*, which have been called *Festuca* but are not truly such There is thus the second heading *Festuca* Linn, followed by "Vide *Bucetum*, *Gouinia*, etc " Other genera in these volumes have been broken up in the same way, such as *Echinocactus*, *Gnaphalium*, *Orchis*

In the "Index" will be found numerous references to Blanco's "Flora of the Philippines" (3rd edition, 1878–80) Blanco was only an

amateur botanist and many of his illustrations are erroneously named The American botanist Merrill has issued a corrected list of Blanco's names Hence, for each incorrectly named illus tration in Blanco there are in the " Index " two distinct references, one giving Blanco's name and the other the correct name 'fide Merrill ", and in each case a cross reference to the other is supplied

In some botanical works, the names on the plates are different from those in the text referring to the same plant This may be due to the fact that the plates were labelled and printed some time before the text was written, when different ideas of nomenclature had prevailed in the author's mind In these cases, again, there are two dis tinct headings in the " Index ", with the necessary cross-reference in each

In John Hill's 'Family Herbal ", dated 1812, the illustrations are mostly very crude, and often names quite foreign to our modern ideas have been given to the plants In these cases the editor has interpreted the plants figured in terms of modern nomenclature For example, *Malva moschata* is called in the book " Vervain Mallow Alcea " Every reference in the "Index" giving the correct name is always followed by the phrase " fide Ed "

An interesting use to which the " Index " might be put would be the tracing of the evolution of the art of depicting any well known or common plant But references to pre Linnæan pictures should, in most cases, be sought for elsewhere than in the " Index " W C W

Our Bookshelf.

Sexual Reform Congress, London, 8 14 IX 1929 W L S R World League for Sexual Reform Weltliga fur Sexualreform Ligue Mondiale pour la Réforme sexuelle Tutmonda Ligo por Seksaj Reformoj Proceedings of the Third Congress Bericht des dritten Kongresses Compte rendu du troisième Congrès Dokumentaro de la tria Kongreso Edited by Norman Haire Pp xl + 670 + 8 plates (London Kegan Paul and Co, Ltd, 1930) 25s net

THE Report of the Sexual Reform Congress held in London in September 1929 contains material of interest to men of science as well as to those concerned with social and moral problems The reader will possibly turn first to Dr Norman Haire's own paper on " Sterilisation, Abortion, and Birth Control ", and will also read with interest Dr Ernst Grafenberg's exposition of his silver ring method of preventing conception Dr Franz E Hirsch's paper on the use of blood tests as indications of paternity, is also of interest, and the method seems to him to be capable of yielding fairly definite results Dr M D Eder, on the " Sterilisation of the Unfit ", is rather doubtful as to the effectiveness of such methods in the present stage of our knowledge We doubt, however, if eugenists will allow themselves to be thus discouraged Dr Bernard Hollander, in his paper, Insanity and Divorce ", urges the amendment of the law so as to allow divorce for incurable insanity

Capt G Pitt Rivers, in his paper, " Sex phobia and Marriage ", claims to have established the interesting and (if true) highly important fact that dense and increasing populations tend inevitably to yield a surplus of women This lends additional interest to Miss R B Kerr's remarks on the " Sexual Rights of Spinsters " The writer claims that the increasing body of women who can afford to bring up one, two, or three children themselves, without the aid of any man, 'should at once be sexually free " Another interesting paper, especially to medical men, will be that of Dr Abraham Stone on " Pre Marital Consultation ", though much of it is a counsel of perfection, at the present time

The value of the papers in this collection naturally varies Feeling themselves under a cloud of opposition, the writers occasionally adopt a propagandist attitude, and here and there we find traces of rhetorical treatment--not so glaring, however, as we should find in the writings of those who take the conservative side in sex affairs On the whole, however, the scientific attitude may be said to prevail J C HARDWICK

Monographs of the Geological Department of the Hunterian Museum, Glasgow University 4 Reports on Geological Collections from the Coast lands of Kenya Colony made by Miss M McKinnon Wood With Introduction by Dr J W Gregory and Report on the Ammonites by Dr L F Spath, Report on the other Mesozoic Mollusca and Brachiopods by Dr J Weir, Report on the Kainozoic Mollusca by L R Cox, Report on the Cheilostomata by Dr H D Thomas, Report on the Echinoidea by Dr Ethel D Currie, Report on the Corals by Dr J W Gregory, Report on the Ostracoda and Foraminifera by Mary H Latham, Report on the Fossil Plants by Dr S Williams, Report on Igneous Rocks by Agnes Neilson, and on the Stratigraphy of the Kenya Coastlands and a List of Localities by Meta McKinnon Wood (Glasgow University Publications, 17) Pp vi + 232 + 24 plates (Glasgow Jackson, Wylie and Co, 1930)

THE fossils described in this monograph were collected by Miss M McKinnon Wood from an area extending from 20 miles north of Malindi to about 15 miles south of Mombasa and stretching inland for 30 to 40 miles along the Kenya-Uganda railway The fossiliferous deposits dip gently toward the coast and are of Jurassic, Cretaceous, Miocene, Pliocene, and post-Pliocene ages The oldest formation of the coastal sedimentary deposits

is the Duruma Sandstone, from which only a few non marine fossils, affording but little evidence of age, were obtained It is thought that this sandstone is mainly of Triassic age, but the lower part is probably equivalent to the Karoo Beds of South Africa

The Jurassic deposits consist of shales and lime stones which, from the evidence of the Ammon ites, appear to range in age from Bajocian to Kimeridgian The Cretaceous is represented by the Freretown limestone, which is regarded as of Urgonian age The Tertiary deposits form a narrow strip along the coast, widening out to the north Of these, the Funda Isa limestones of Lower Miocene age (Aquitanian Burdigalian) contain a molluscan fauna closely related to that of contemporaneous deposits in Madagascar, Persia, and India, but a small number of the species are known to occur in the Lower Miocene of the Mediterranean region and indicate that some communication must have existed between the two regions The North Mombasa Crag is of Lower or Middle Pliocene age The mollusca in the post-Pliocene deposits belong mainly to species which are widely distributed throughout the Indo Pacific province, but include three species which are not known to be living on the west side of the Indian Ocean

The Year Book of the Scientific and Learned Societies of Great Britain and Ireland a Record of the Work done in Science, Literature and Art during the Session 1929–1930 by numerous Societies and Government Institutions Compiled from Official Sources Forty-seventh Annual Issue Pp vii + 384 (London Charles Griffin and Co, Ltd, 1931) 18s net

Messrs Charles Griffin and Co, Ltd, deserve the thanks of scientific workers generally for the money and care they have expended during the past half century on the production of this useful reference book This, however, is to be the last time we shall be able to welcome its appearance—at least, in its present form For those who are unacquainted with the volume, we may say that it contains particulars as to the names, addresses, meetings, membership, and publications of the scientific and learned societies of the British Isles and of Government scientific departments, and to each society, where the information is available, is appended a list of the papers read during the session 1929–30 The societies are classified by their subjects The information given is 'official' in the sense that it is supplied by officials, honorary or otherwise, of the societies, institutions, and laboratories dealt with, and we are grateful for the trouble they have taken

Future issues of the book will be shorn of the lists of papers We are sure this is a wise decision Even though the lists are the latest available to the compilers, the titles of papers read during the session 1929–30 seem out-of date in a reference book issued in 1931, and by their omission the size of the volume and cost of production should be considerably reduced This in turn should react favourably on the sales, for the essential part of the book for reference purposes will remain We hope it will be possible to retain the distinctive and serviceable binding in the new series

A Handbook of English in Engineering Usage By Prof A C Howell Pp vii + 308 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 12s 6d net

It is seldom that a book appears which can be regarded as unique in the subject matter with which it deals, but this may be truly predicated of Prof Howell's engrossing work It is a shining example of the principles enunciated, and it is pleasant to peruse the flowing periods and incisive remarks permeating the pages The advice that a writer should project himself into the reader's position is well urged A fault to which attention may be directed, however, is that the text is unduly protracted, and there is a tendency to reiteration In places, too, are encountered erroneous examples on phrasing—such as "The message will be delivered to *whoever* is authorized", "The kind of *pens* is the best", "*one* must write *his* paragraph" may be cited For a book on engineering phraseology there are too many examples of non engineering sentences given as illustrations The author's remarks on reviewing, editorials, and cognate matters are inspiring In a work like the present, the use of "*the same* letter", when "*a similar* letter" is intended, would not be expected In conclusion may be commended the maxim on p 93, "There is a vast difference between having to say something and having something to say" P L M

Vertebrate Embryology By Prof Waldo Shumway Second edition, thoroughly revised Pp x + 311 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1930) 18s 6d net

The text-book of vertebrate anatomy by the professor of zoology in the University of Illinois was so eminently useful, being concise and lucid, and illustrated by an adequate number of very clear diagrams, that it is not surprising to record the appearance of another edition, which has been revised and improved It provides an account of the early development of *Amphioxus*, the frog, the chick, and man, the formation of their germ-layers, embryonic membranes and bodily form, and an excellent section dealing with organogeny The third part of the book consists of a very instructive atlas of sections, which includes drawings of a valuable series of pig embryos Part four is concerned with technique and deals with the preparations of embryological material, the use of the microscope, the making of drawings, and reconstructions

This book can be recommended to any demonstrator of zoology or anatomy who wishes to provide a course that is well adapted to the needs of the medical student In those laboratories which are so fortunate as to possess the necessary embryological material, the book will serve as an excellent guide to the student

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

An Egyptian Axe-head of date 1800 B C its Investigation and Reproduction

SOME months ago, Mr Guy Brunton asked me whether I would examine and report upon an Egyptian axe head It was one of several specimens of the same date He was so good as to give me permission to destroy this particular specimen if it was necessary in the interests of a full scientific investigation This examination I have now been able to complete, and it may be of interest if I add that, except in one particular—and this, I think, would only be noticed by experts—the specimen has been in no way injured I emphasise this, because the natural objection to their injury or destruction is the reason why so few investigations have been allowed to be made of ancient metal specimens

FIG 1 ×7

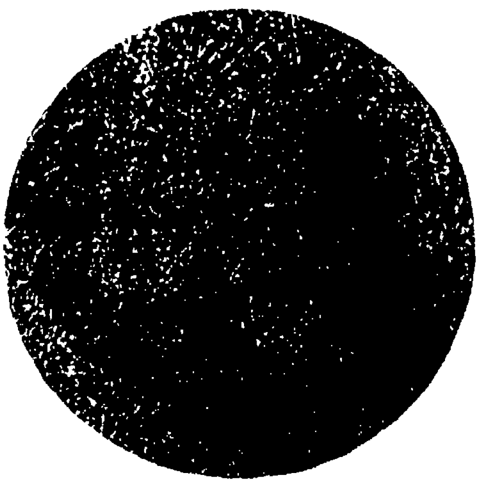

FIG 2 ×7

The axe head, the outline of which is shown in Fig 7 (× ⅓), was coated with a green patina This bore the pattern of the fibre wrapping in which it had been enclosed It was removed by means of a wire brush with dilute hydrochloric acid Underneath was a thin layer of cuprite which coated the metal This also was removed The metal itself was copper-coloured, but etching with ammonium persulphate developed a dendritic structure on the surface which showed that the material was not pure copper but an alloy of high copper content The appearance of the deeply etched surface at a magnification of 7 diameters is shown in Fig 1 The dendritic structure also showed that the axe head was made from 'cast' material and the fact that the dendrites were not appreciably distorted showed that it was cast and not forged to shape Even at its edge there was no evidence of severe working, as is shown in Fig 2

FIG 3 ×100

At higher magnifications it was seen that the metal had completely recrystallised and that the resulting crystals were twinned This showed that the casting had been worked to some extent and had been annealed during or after this treatment These twin crystals are shown in Figs 3 and 4 at 100 diameters magnification The dark markings (called 'cores') represent some of the original structure of the specimen

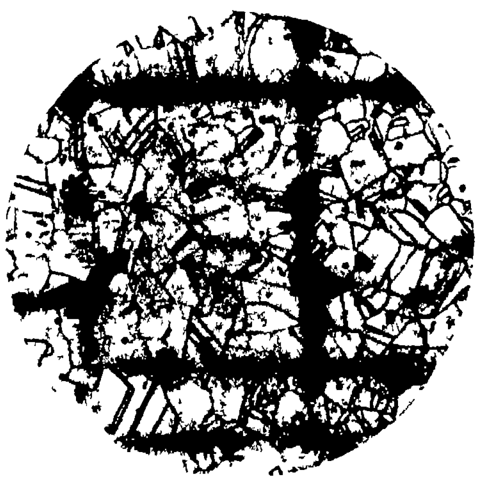

FIG 4 ×100

and constitute definite evidence that it is an alloy Speaking broadly, the recrystallised grains were undistorted, but some of the twin bands were slightly bent, as is clearly shown in Fig 5 at 250 diameters magnification This slight local distortion of the structure indicates that the annealed axe head had been subjected to a comparatively mild and rather uneven form of cold working, such as hammering

Fig 5 ×250

The Brinell hardness of the axe head varied from about 90 on the flat to 112 at the edge The hardness, measured with a 1 mm diameter ball, varied considerably from place to place on the surface, indicating either that the axe head was not homogeneous or that it had been unevenly work hardened Both these conclusions are in agreement with the microscopic evidence The hardness measurements are shown in Table I and in Fig 7

Chemical analysis showed that the axe head contained 96 9 per cent of copper, 1 5 per cent of arsenic, 0 7 per cent of iron, and 0 2 per cent of tin The remaining 0 7 per cent included small quantities of nickel, sulphur, and oxygen

An experiment was then made to reproduce the axe head An alloy of the same shape and composition was cast in sand and was then subjected to the mechanical and thermal treatments which the microscopic and hardness data indicated the Egyptian axe head had received First of all, the casting was hammered lightly with a 7 lb hammer It was then annealed for periods of 15 minutes at intervals of 50° C from 400° C upwards until the metal recrystallised and the crystal grain size became approximately the same as that of the axe head This occurred at 700° C The pronounced "coring" of the cast alloy became less distinct as the annealing temperature was raised, and at 700° C was comparable with the structure of the axe head The annealed alloy was finally re hammered Brinell hardness measurements of the alloy were made at all stages of the above treatments They are shown in Table I

Table I

Material	Treatment	Hardness		
		Maximum	Minimum	Average
Axe head	As received	112	82	97
	Annealed at 700° C	61	54	57
Copper arsenic iron tin alloy of the same composition cast in the laboratory	As cast	60	53	56
	Hammered	106	86	96
	Annealed at 700° C	63	56	59
	Re hammered	103	82	93

As will be seen from the table, the hardness of the re hammered alloy agreed satisfactorily with that of the axe head

Fig 6 ×250

The microstructure of the re hammered casting is shown in Fig 6 at 250 diameters magnification A comparison of the crystal grain size, the distortion of the twin bands, and the unevenness of the etching (which represents the coring in this photomicrograph) with the corresponding features in Fig 5 shows that the alloy synthesised in the laboratory markedly resembled the axe head both in microstructure and in hardness

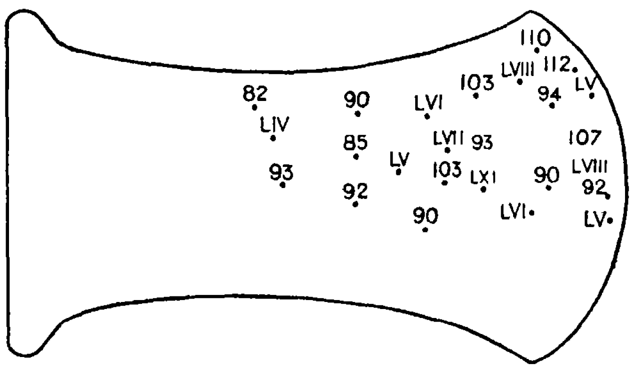

Fig 7 —Outline of axe head • Brinell hardness 1 mm ball, 10 kgm load As received, Arabic numbers annealed Roman numbers

The experiments all lead to the conclusion that the Egyptian axe head was cast to shape, worked to some extent—no doubt by hammering—and annealed at about 700° C either during or after the mechanical working In order still further to test these deductions, the axe head itself was annealed at 700° C for 15 minutes and its Brinell hardness then measured The readings which are shown in Table I (line 2) are in good agreement with those of the annealed casting (line 5)

The hardness at various points on the surface of the axe head before and after annealing are shown in Fig 7 It will be noticed that the hardness of the edge, originally as high as 112 Brinell, was reduced to about 55 by annealing It was thus approximately halved This means that the work hardening capacity of the alloy is high Although the maximum hardness of the edge is somewhat surprising, considering the low

alloy content of the copper and the comparative mildness of the cold working, it is not so high as to lend support to the view that the Egyptians possessed a method of hardening copper with which we are unacquainted The hardness of the axe head was produced partly by alloying and partly by cold working By a suitable choice of alloying elements and more effective mechanical treatment, much greater hardness can be produced to day

One further conclusion may be drawn This investigation has made it possible to answer the question whether hardening by cold work is permanent in an alloy of this type at the ordinary temperatures According to Mr Brunton's view, the axe head is more than 3700 years old When I discussed this question with him and the extent to which this date might be in doubt he was willing to advance it 200 years but no more Accepting this, its age is at least 3500 years No one, of course can say whether it has lost any of its original hardness, but it is quite clear that it has retained a considerable amount of work hardness throughout this long period

I wish to acknowledge the assistance of two members of my staff, Mr C W Dannatt and Dr M S Fisher, in the above investigation

H C H CARPENTER

Royal School of Mines South Kensington,
London, S W 7, March 9

Constitution of Rhenium

OWING to the kindness of Dr Noddack who provided me with a sample of the heptoxide of his recently discovered element rhenium, I have been able to obtain its mass spectrum Re_2O_7 is a slightly volatile greenish crystalline solid Its vapour was first admitted to the discharge like that of osmium tetroxide, but with no success The solid was then introduced into the discharge tube and heated in the cathode ray beam, but although the volatilisation was ultimately such as to cause a visible dark layer on the surrounding walls, not the slightest sign of its mass spectrum could be obtained The substance seemed hopeless, so I proceeded to my next investigation, which was an attempt to get the mass spectrum of gold by volatilising its chloride This compound is unstable and, as the presence of halogens had on some previous occasions brought out the lines of other bodies in a remarkable way, it seemed just worth while to volatilise it in the discharge tube before the rhenium oxide deposit had been removed from the walls This procedure was successful beyond all expectation Although no lines of gold were visible the doublet lines of rhenium appeared in great intensity and in addition were repeated 16, 32, and 48 units higher as ReO, ReO_2, and ReO_3, so giving unusually convincing evidence of its constitution

Rhenium consists of two isotopes, 185, 187, as was expected from the general rule that complex elements of odd atomic number (above 9) consist of two odd mass numbers two units apart, but it is the first element analysed in which the heavier isotope is the more abundant The ratio of this abundance was estimated photometrically by analogy with the mercury lines to be 1 62 1 The position of the line 203 due to $Re^{187}O$ in the mercury group was used to determine its packing fraction, which is -1 ± 2, the same as that of osmium From these provisional values the atomic weight on the chemical scale works out at $186\,22 \pm 0\,07$, in good agreement with Hönigschmid's latest value of 186 31 The strongest isotope of rhenium is isobaric with the weakest of osmium

F W ASTON

Cavendish Laboratory Cambridge Mar 31

The Behaviour of Antiknocks

IT is generally agreed that it is the metallic radicle of an organometallic antiknock compound that is mainly responsible for the delaying of the oxidation of a combustible mixture That the metal atom is in an oxidised state before it becomes effective, was an inference made on the basis of many different experimental facts, for example, the behaviour of potassium vapour,[1] but it has not been proved directly We have recently been able to show that a small quantity of lead tetraethyl vapour, when let into an evacuated vessel heated to 265° C into which a charge of pentane vapour and oxygen is afterwards introduced, will not affect the course of the combustion to any great extent and may even accelerate it, but that if some oxygen is let into the vessel before the lead tetraethyl vapour, and then this followed by the bulk of the charge, the combustion is invariably strongly inhibited These experiments provide direct evidence that the lead must first be oxidised before it is effective as an inhibitor It is possible that the accelerating effect is due to the C_2H_5 radicles which help to start reaction chains, but that has yet to be proven

A EGERTON
L M PIDGEON

Clarendon Laboratory, Oxford

[1] See Egerton and Gates, *J Inst Petm Tech* **13** 244 1927

Pasteurised and Raw Milk

IN NATURE of Mar 21, p 466 an abstract appears of a report issued by the Department of Health for Scotland on "Milk Tests in Lanarkshire Schools", by G Leighton and P L McKinlay In this experiment, nearly ten thousand school children received a supplementary ration of three quarters pint of milk daily for about four months Two important tables from the report showing the average increases in height and weight of the children, divided into 14 groups by age and sex, are reproduced

The special point to which we wish to direct attention concerns the apparent contrast in the effects of pasteurised with that of raw milk About half the children receiving milk consumed it raw, while the other half were supplied with milk from the same source which had been pasteurised It is somewhat unfortunate, however, that the recipients in the same school were never so divided, the whole of the milk supplied to any one school being either raw or pasteurised In the absence of the records from the separate schools it is impossible altogether to eliminate the doubt which this choice of method introduces nevertheless, the report concludes with the statement (p 20)

"In so far as the conditions of this investigation are concerned the effects of raw and pasteurised milk on growth in weight and height are so far as we can judge, equal"

The importance of such a conclusion, if well established is manifest It is however open to some question, for Table 12 printed on the same page, shows that of the 14 groups (by age and sex), pasteurised milk gave a greater increase in height in only 2 groups, the increases were equal in 1 group, while in 11 groups the raw milk gave the greater increase If we may regard these as 14 independent experiments, the difference from expectation on the hypothesis that raw and pasteurised milk have the same effects, is such as would only occur once in about ninety trials, and it seems evident that the conclusion should have been that the *growth response in height to raw milk is significantly greater than that to pasteurised milk*

In order to examine the magnitude of the difference

we have calculated from Tables 6 and 7 of the Report the average increments in the control, raw milk and pasteurised milk groups, weighting the averages given according to the total numbers of boys and girls in each group In this way we find an average increase in height and weight, standardised for age, for the whole group of children observed From the average increase, the excess ascribable to milk feeding is obtained by subtraction, and the relative value of pasteurised as a percentage of the value of raw milk, as measured by increase in growth, is calculated from the two differences

AVERAGE INCREASES IN WEIGHT IN OUNCES

	Boys		
	Control	Raw Milk	Pasteurised
Increase	10 041	13 780	12 507
Excess over control		3 739	2 466
Value per cent		100 0	66 0

	Girls		
	Control	Raw Milk	Pasteurised
Increase	9 755	14 315	13 907
Excess over control		4 560	4 152
Value per cent		100 0	91 1

In weight the average increment ascribable to the consumption of about 10 gallons of milk is a little more than 4 ounces, being a little more for girls than for boys In both sexes the pasteurised milk gives a lower return, the increment ratios being 66 0 per cent in the case of boys, and 91 1 per cent in the case of girls In respect of growth in height the contrast is even more striking

AVERAGE INCREASES IN HEIGHT IN INCHES

	Boys		
	Control	Raw Milk	Pasteurised
Increase	0 7274	0 8145	0 7707
Excess over control		0 0871	0 0433
Value per cent		100 0	49 8

	Girls		
	Control	Raw Milk	Pasteurised
Increase	0 7300	0 8140	0 7889
Excess over control		0 0840	0 0589
Value per cent		100 0	70 1

Measured by its effect in increasing growth in height, pasteurised milk appears from these data to have only half the value of raw milk in the case of boys, and about 70 per cent of the value in the case of girls

These results are put on record to avoid the danger that, from a superficial examination of the report, the conclusion should be drawn that this extensive experiment demonstrates the equivalence of pasteurised and raw milk In reality the reverse is the case, and the very marked difference in response to two materials, which in their gross nutritional contents are so closely equivalent, raises a problem of very great interest, which can probably only be cleared up by more deliberate experimentation The contrast between the response to pasteurised milk and that to raw milk is of value also in interpreting the difference between the milk-fed and the control children, for it would evidently be extremely rash to draw from the experimental results the 'natural' conclusion, that the increases induced by milk feeding indicate that the Lanarkshire children are, in their normal diet, inadequately supplied with such nutrients as fat, protein, or sugar, which are contained equally by the raw and by the pasteurised milk

R A FISHER
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Capture of Electrons from Mercury Atoms by Positive Ions of Helium.

IN a recent paper[1] we gave an account of some experiments on the determination of the mobility of ions in helium gas at a pressure of 360 mm of mercury We found that the mobility of the positive ions decreased when small traces of other impurities were introduced into the apparatus, and we interpreted the results as due to an 'exchange' phenomenon similar to that observed by Kallmann and Rosen in the case of high speed positive ions On this view, when a helium ion 'collides' with an impurity molecule there is a certain probability that an electron will be captured from the impurity by the ion The impurity ion so formed will not lose its charge in collisions with other helium atoms, because the ionisation potential of helium is greater than that of any impurity and the speed of the ions in our experiment is much too small to supply the energy required for the transition For this reason, a very small concentration of impurity is sufficient to change completely the rate at which the positive charge is carried through the gas

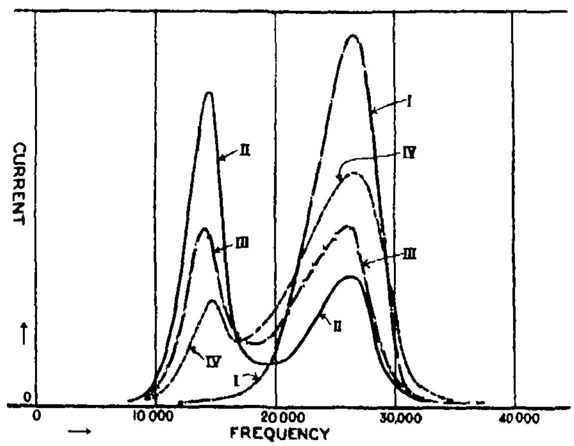

FIG 1

In our first experiments we had not sufficient control of the purity of the gas to identify the impurities which gave rise to ions of smaller mobility We have now made experiments in a new apparatus in helium at 20 mm pressure and have obtained a definite example of the exchange phenomenon from helium to mercury

In our method of measuring the mobility of ions in gases, a peak is obtained in a current frequency curve for each type of ion present (Fig 1). Curve I shows the curve which we obtained for positive ions in pure helium in a baked-out apparatus, mercury vapour being excluded by liquid air traps. On

admitting mercury vapour to a concentration of one part in 30,000 of helium, Curve II was obtained. It will be seen that instead of the original single peak, two peaks are now present. The peak at the higher frequency coincides in position with the original single helium peak and is due to helium ions which have traversed the apparatus without losing their charge by interchange to mercury. The peak at the lower frequency indicates the presence of mercury positive ions which have been formed by electron capture from helium ions. On freezing out the mercury with liquid air, Curve I was again obtained. Curves III and IV are for successively smaller concentrations of mercury and show corresponding reductions in the number of mercury ions. Though some of the mercury ions may possibly arise from collisions of mercury atoms with metastable atoms of helium in the neighbourhood of the primary source of ionisation, the greater number at least must be due to electron exchange. This was shown by giving the ions a longer life before entering the analysing part of the apparatus; the relative number of mercury ions was then found to increase, roughly linearly with the age of the ions.

These results not only give an illustration of electron capture but also afford a method of determining the mobility of positive ions, other than those of helium, moving in helium gas. Thus the ratio of the mobility of a mercury positive ion in helium to that of a helium ion in helium is 0.55.

Also, by repeating the measurements with known minute concentrations of other gases, we may hope to determine the target area for electron capture presented by their molecules to helium ions of very slow speed. Experiments on these lines with hydrogen, nitrogen, and other gases as impurities are now in progress.

C. F. POWELL.
A. M. TYNDALL.

Henry Herbert Wills Physical Laboratory,
University, Bristol,
Mar. 25.

[1] Tyndall and Powell, *Proc. Roy. Soc.*, vol. 129, 1930.

Spectra of the Helium Glow Discharge

FOR some time past we have been investigating the cold cathode glow discharge in helium with probe wires, for approximately 'normal' conditions at a pressure of about 1 mm. of mercury. The work with cathode falls in potential less than 100 volts is still incomplete, but two cases in which we have been able to correlate the spectrum with the electrical data are of some interest.

The first concerns the distribution of intensity in the arc spectrum (He I). This is well illustrated by the behaviour of the lines at 5016 A. and 4713 A., the latter being very feeble compared with the former in the negative glow, whilst the two are of comparable intensity in the anode glow. From the current voltage characteristics of the probe wires, we find that the distribution of velocities amongst the electrons is not Maxwellian in the negative glow, but can be represented fairly closely by the superposition of several Maxwellian groups; in a typical instance, the temperatures of these were 300,000°, 54,000°, and 4900°, and the concentrations 8×10^{8}, 5×10^{7}, and 1×10^{9} per c.c. respectively. In the anode glow, in another instance, a single group was present, with a temperature of 60,000°. From these numbers, we can calculate the relative intensities to be expected for the lines, from data given by Elenbaas [1] for their intensities when they are excited by electrons of definite speeds. It can be shown in this way that λ5016 would be expected to be about 17 times as strong as λ4713 in the negative glow, but only 4.5 times as strong in the anode glow, in reasonable agreement with our visual estimates. Our previous conclusion [2] that electrons with anything like the full cathode voltage are not present in at all large numbers under these conditions also receives confirmation from the extremely feeble intensity of the spark line λ4686.

The second observation is that Seeliger and Mierdel's suggestion that metastable atoms are rapidly destroyed by slow electrons [3] finds support from our measurements if at least one of the two atoms which go to the formation of a molecule He_2 is initially in such a state. It is found, as Seeliger and Mierdel supposed, that helium bands appear only in those parts of the discharge where there is a considerable concentration of relatively fast electrons (with energy greater than 20 electron volts) and a *small* concentration of slow electrons (with energy less than about 1 electron volt). The kinetics of the processes involved are not clear, but the atomic process coming into play in the destruction of metastable atoms by slow electrons is possibly the converse of that which causes the sharp maximum in their excitation functions.

H. McN. COWAN.
W. L. BROWN.
K. G. EMELÉUS.

The Queen's University, Belfast,
Mar. 28.

[1] *Zeits. f. Physik*, 59, p. 289; 1930.
[2] *Phil. Mag.*, 7, p. 17; 1929.
[3] *Zeits. f. Physik*, 19, p. 230; 1923.

Isostasy

IN scientific literature of to-day dealing with geophysical matters one frequently meets assertions that the hypothesis of isostasy is universally established. Prof. Heiskanen begins a recent article,[1] "In recent years geodesists, geophysicists, and geologists have studied extensively isostatic compensation and it can be considered as a proved fact that isostatic compensation prevails, at least in North America (Hayford, Bowie), in India (Pratt, Airy, Burrard, Crosthwait), etc." I consider this statement far from true as regards India. Pratt and Airy, whose work is published in the *Phil. Trans. Roy. Soc.* (1854–59), had only three values of the meridian value of the deflection of the vertical on which to base their studies. Pratt *suggested* the idea of *mountain* compensation; but he did not completely satisfy the observational points. Burrard in 1901 [2] did not agree with Pratt's conclusion; later on, however, in 1918,[3] by extending the scope of Hayford's isostatic hypothesis to include compensation of density anomalies, he was able to satisfy the observational data then existent in the Himalaya and neighbouring regions by attributing appropriate depth to such anomalies. Crosthwait in 1912 [4] wrote "Speaking generally, it would appear that isostatic conditions are much more nearly realised in America than in India." He had made the necessary calculations for the Hayford deflection at 102 latitude stations and 18 longitude stations distributed over India.

My recollection of the opinion held in 1912 in the Survey of India was that a state of isostasy did not exist in India. Later, in 1918, Burrard was inclined to think otherwise.

Since 1918, however, the results of observations at many more deflection stations have been considered (229 latitude, 19 longitude—227 azimuth). We have studied these intensively during recent years. Meantime the number of pendulum stations has increased from 118 in 1918 to 205 in 1930. The form of the geoid as traced from the value of deflection has been

supported by its accord with the pendulum anomalies The conclusions drawn are as follows [5]

(a) That in peninsular India in general, isostatic compensation definitely does not prevail An area of 100,000 sq miles in the Gangetic Plain shows an anomaly ranging from 1000 to 6700 feet equivalent surface rock, while north of Nagpur is an area of 50,000 sq miles with anomaly ranging from - 1000 to - 3700 feet of rock

(b) That in Himalayan regions there is some measure of compensation, but the total area in which adequate observations have been made is small

It is entirely wrong then to quote India as a region supporting the hypothesis of Hayford isostasy Isostasy *may* prevail in the Himalaya, as Pratt suggested, but it does not prevail over the remaining portion of India

J DE GRAAFF HUNTER
(Director, Geodetic Branch)

Survey of India, Geodetic Branch Office,
Dehra Dun, Jan 25

[1] Isostasy and the Figure of the Earth *American Journal of Science* vol 21 No 121 January 1931
[2] Survey of India *Professional Paper* No 5
[3] Survey of India, *Professional Paper* No 17
[4] Survey of India, *Professional Paper* No 13
[5] Details of all the work are given in *Geodetic Reports*, vol 1 1 5

Origin of Cosmic Radiation

THE frequency ν of radiation can be deduced from its absorption μ by means of the well known formula of Klein and Nishina,[1] which can be put in the form

$$\mu = \frac{2\pi N e^4}{m^2 c^4} f\left(\frac{h\nu}{mc^2}\right)$$

This gives frequencies which agree well with experiment up to the frequencies of the hardest γ rays, beyond this it is impossible to test it

The formula supposes absorption to result entirely from scattering by free electrons (N per cubic cm) In dealing with γ radiation, all extra nuclear electrons are treated as free, since (in the language of classical theory) their period of oscillation is long compared with the period of the incident radiation The nuclear electrons and protons have 'periods of oscillation' comparable with those of γ radiation and so must not be treated as free, except when the incident radiation is of far shorter period than γ radiation Cosmic radiation comes within this latter category, whence it appears probable that in deducing the wave length of cosmic radiation by the Klein Nishina formula N ought to refer to all electrons, nuclear as well as extra nuclear, and not merely to the latter A second term ought also to be added to represent scattering by protons, but calculation shows that this is entirely insignificant The effect of taking the nuclear electrons into account is to double, or more than double, the absorbing power of all atoms except hydrogen It increases the absorbing power of water for cosmic radiation to eighty per cent above the value usually calculated

The following table shows the absorption (per metre of water) calculated for the radiation produced by the synthesis of iron, and by the annihilation of 1, 2, and 4 protons and their accompanying electrons

Process	$\frac{h\nu}{mc^2}$	Calculated μ Extra nuclear electrons	Calculated μ All electrons	Observed μ (Regener)
26 H → Fe	876	0 076	0 136	
+ − → O	1845	0 039	0 071	0 073
+ + − − → O	3690	0 021	0 038	
+ + + + / − − − − → O	7380	0 011	0 020	0 020

The last column gives the true absorption of the two most penetrating constituents of cosmic radiation, as analysed by Regener [2] The agreement with the figures in the preceding column is probably well within errors of observation Although the problem is beset by every kind of uncertainty, this agreement at least suggests that the most penetrating constituent so far observed in cosmic radiation may originate in the annihilation of an α particle and its two neutralising electrons (the components of a helium atom), while the next softer constituent may originate in the annihilation of a proton and its one neutralising electron (the components of a hydrogen atom) Such an interpretation leaves no room for radiation originating in the simultaneous annihilation of two protons and two electrons which would result in a unit decrease in atomic number Although this may seem surprising at first it accords well with the marked differentiation between elements of odd and even atomic numbers, with the fact that radioactive atoms eject α particles but never protons, with the fact that no atom of atomic weight 2 is known, and also, I think, with the general spirit of nuclear physics

These two constituents appear to be far too hard to be produced by the synthesis of iron, while the synthesis of heavier elements would seem to be ruled out by their rarity in the universe If the annihilation of matter is the true origin of the two hardest constituents of the cosmic radiation, it would seem likely that these and these alone form the fundamental radiation and that all other constituents represent mere softened or degraded forms of these No calculation I have ever been able to make seems at all friendly to Millikan's suggestion [3] that the hardest radiation of all has its origin in the synthesis of iron

J H JEANS

Dorking, April 9

[1] NATURE **122** p 398 Sept 15 1928
[2] NATURE **127** p 233, Feb 14 1931
[3] *Physical Review*, Feb 1931, p 250

Chemistry of Vitamin B_2

A CHEMICAL study of vitamin B_2 in a cold aqueous extract of commercial liver extract (Eli Lilly, No 343) has been made This solution is very rich in vitamin B_2, being effective in producing good growth in young rats on a B_2 deficient diet, in a daily dose representing 40 60 mgm of the original liver extract

Picric acid and benzoyl chloride do not precipitate the vitamin, nor is it precipitated or destroyed by nitrous acid It is not precipitated by flavianic acid Neutral lead acetate partially precipitates the active material both at pH 4 6 and 7, while litharge does not precipitate it at all Silver nitrate precipitates the bulk of the vitamin Baryta does not precipitate it either in an aqueous solution or in a medium of 50 per cent alcohol 'Norite' charcoal adsorbs the factor at the natural pH of the aqueous liver extract (pH 4 6), which, however, could not be eluted by acid, alkaline or neutral water alcohol mixtures, or by a dilute solution of saponin Three extractions with 30 per cent propyl alcohol appeared to extract it partially with a considerable loss of activity Treatment with phosphotungstic acid gives an inactive precipitate and a filtrate with a small degree of activity A combination of the two is equally unsatisfactory Esterification with ethyl alcohol leaves the bulk of the activity in the non esterified portion, the ester itself being almost wholly devoid of activity Trypsin has no effect on the vitamin

On the basis of the present evidence it appears that, if the vitamin is a single chemical entity, it is probably not a base, an acid, or a peptide, but a neutral

substance Preliminary experiments on the electro dialysis of vitamin B_2, carried out with Mr T W Birch, also appear to support this conclusion These fractionation experiments have given the general impression that vitamin B_2 is fairly readily adsorbed by neutral precipitates Thus, the partial precipitation by lead acetate and also by silver nitrate is probably merely due to the adsorption of the vitamin on to the precipitates formed

Though the liver extract is potent in both vitamin B_2 and the factor specific for pernicious anæmia they appear to be different from evidence of the methods of their fractionation and also on other grounds

The stability of vitamin B_2 to heating under pressure in an alkaline medium shows curious discrepancies Commercial liver concentrate and commercial yeast extract ('marmite') are both fairly stable to autoclaving at pH 9 at 124° C, while aqueous extracts made from brewer's yeast, fresh ox liver, and ox muscle are markedly unstable under the same conditions The stability appears to be connected with the presence of certain protective materials in a given fraction

The vitamin is stable to sulphur dioxide hydrogen peroxide, and ozone

B C GUHA

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Embryology and Evolution

DR A PINEY, in his letter to NATURE of Feb 28 accuses me of reviving a dormant form of vitalism but with the deification of entelechy I certainly have no association He says The sterility of vitalistic hypotheses in the past leads one to doubt their fertility in the future", but the fecundity of alternative hypotheses is not conspicuous

Dr Piney defines science *in modo et forma* with masterly assurance that the man of science has no concern with what lies outside his conceptual schemes, yet the actual instability of such schemes indicates that the real motive of the scientific worker is the attempt to discover what Dr Piney himself admits may be of the greatest importance

As biologists, whether we incline to the belief that the living cell is something self contained and perfectly unique in the universe, or whether we suspect that it, in common with the rest of matter, is subject to obscure external forces, our confession in regard to the control of vital processes, so far, is one of ignorance But those of us who feel that the living cell is a machine in miniature, the very life of which depends, as a familiar fact, upon its reception of electromagnetic radiations of the order 8000 to 4×10^6 A, may perhaps be pardoned for suspecting that the protoplasmic cogs are driven by external forces, even though we profess no adherence to the views of the great Nicholas of Cusa

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Mar 21

High-flying Egrets at Night

ASTRONOMICAL and ornithological readers of NATURE may be interested to hear of a somewhat extraordinary experience I had rather early in the morning of Feb 16 while sweeping for comets About 12 30 A M I was suddenly startled to see in the field of view of my 7¼ inch reflector, using an eyepiece giving about 35 power, about twelve to fifteen large golden coloured objects, like third magnitude stars much out of focus, and thus enlarged, crossing the field at a fair pace At first I wondered what it could be It was as if a star cluster like the Pleiades had suddenly taken to flight I soon recognised as I followed the objects in the telescope that they were a flight of the little white egrets, passing a little more than a mile away, and so high up that the electric lights of the city lit up the under side of their wings, giving them a golden colour like stars I followed them for about two minutes first in the reflector and then in the finder, until they got out of my reach towards the west When first I saw them they were perhaps a little to the east of the Southern Cross, and about the same altitude, say 45°–50° They travelled west and passed 4° or 5° below Canopus, and then I lost them, as they got too far west for my balcony

These egrets are often seen in these parts following cattle and eating the flies in their track or on their bodies It would be interesting to know if anyone has seen such a thing at night before They were flying in a wedge shape, and I could see the motion of their wings probably about one mile high and one mile away Of course, in the daytime birds have been seen crossing the sun's disc, but this was midnight

THEODORE B BLATHWAYT

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Feb 16

Fine Structure in the Mercury Singlet Terms: A Correction

I WISH to direct attention to an error in the particulars I have recently given [1] of the fine structure of the line λ6234 ($7\,^1S_0 - 9\,^1P_1$) in mercury The positions of the components g and f given as – 0 406 and – 0 696 cm^{-1}, are actually 0 306 and – 0 544 The diagram in Fig 2 requires a corresponding emendation The corrected value 306 for the interval bf in $7\,^1S_0$ $9\,^1P_1$ now agrees reasonably well with the interval 308 (be) of λ5676 ($7\,^3S_1 - 9\,^1P_1$) and its previous allocation to the $9\,^1P_1$ level is thus confirmed Further, the intervals 31, 121, 156 which occur in the $9\,^1P_1$ term are now seen to be consecutive since their sum 308 is established as a real difference The main conclusions reached in the paper are not affected by the error

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Mar 25

[1] *Proc Roy Soc* A 130, 559 1931

The Theory of Geological Thermal Cycles

DR J H J POOLE's opening paragraph (NATURE, April 4 p 518) suggests that in my first criticism of Prof Joly's theory I did not consider the possible effects of fusion in the production of periodicity On the contrary, the main topic of the paper was to discuss whether fusion could have such an effect, and none was found

I need scarcely say that I do not share Dr Poole's doubt as to whether a fluid, with internal generation of heat, would maintain the adiabatic gradient of temperature There is abundant theoretical reason for this, and it is in accordance with meteorological experience

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St John's College,
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Canadian Hydro-Electric Power Development during 1930.

By Dr BRYSSON CUNNINGHAM

THE remarkable progress which, during recent years, has characterised the development of natural sources of water power in Canada for the generation of electricity and other industrial uses continues at an unrelaxed pace, and the two annual reports [1] recently issued by the Canadian Government contain a record of activities during 1930 which is quite up to the standard of preceding years. The present rate of development in round figures is 400,000 additional horse power a year, and as the aggregate has grown from $3\frac{1}{2}$ million horse power in January 1924 to a little more than 6 million horse power in January 1931, it is obvious that, roughly, the rate has now been maintained for a period of seven years. Taking the comparative value of coal fuel for power generating purposes at $5\frac{1}{2}$ tons per annum per horse power (the most recent estimate), it can be inferred that Canada is progressively supplementing her extremely meagre resources in mineral fuel by the equivalent of a supply of about $2\frac{1}{4}$ million tons of coal per annum. Moreover, as compared with coal, water power energy has the advantage of perpetuity, for, once installed, the turbines may continue to function for an indefinite period, in contradistinction to the inevitable, though gradual, exhaustion of fuel used in thermal stations.

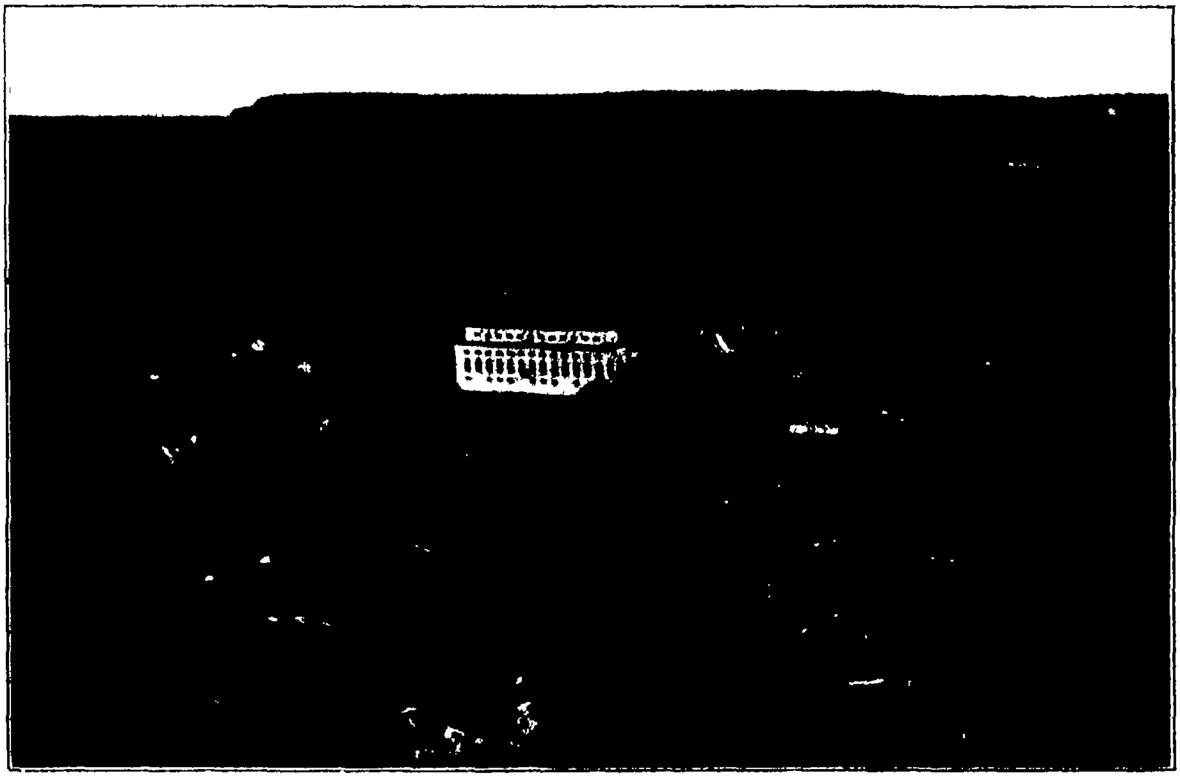

FIG 1 —Cameron Falls development, Nipigon River, Ontario (75,000 horse power) of the Hydro-Electric Power Commission of Ontario (By courtesy of the High Commissioner of Canada.)

The precise figures of available and developed water power, as ascertained to Jan 1 last, are set out in the table on p 597. They may be instructively compared with the corresponding statistics at Jan 1, 1930, which were published in NATURE on May 31 last.

It will be noted that there has been no further revision of the total available horse power, which still stands at 33,617,500 (ordinary six months' flow), although the report indicates that, in some of the more remote and less explored districts, the figures must be accepted as provisional and subject to expansion as the work of surveying and tabulation proceeds. Moreover, the present estimates are of a decidedly conservative character, as may be gauged from the fact that actual development of existing sites has produced power some 30 per cent in excess of the calculated maximum. Hence it is fairly safe to say that the total water horse power assets of Canada are of the order of 43 or 44 millions. According to information gathered from reports of the United States Geological Survey, this compares roughly with about 80 millions in the United States. The water power resources of Great Britain on this scale are insignificant: perhaps a million, or, at the outside, a million and a half.

As regards actually developed power, the aggregate increase throughout the Dominion is 397,850

horse power, of which the bulk has been realised in the provinces of Ontario and Quebec, though notable progress has also been made in British Columbia, Saskatchewan, and New Brunswick Very little change has taken place in Nova Scotia, and the other four provinces remain stationary

The province of Ontario heads the list of increments with 136,000 horse power The most important item in this total is a tenth unit of 58,000 horse power added to the Queenston station at Niagara Falls, bringing the aggregate capacity of the station, which is the largest in Canada, up to the imposing figure of 560,000 horse power Almost as large an increment is the recently completed 54,000 horse power development on the Nipigon River at Alexander Landing, a short distance below the 75,000 horse power installation at Cameron Falls (Fig 1) The Hydro Electric Power Commission of Ontario has at present in hand, in conjunction with the Ottawa Valley Power Company, the development of Chats Falls, on the Ottawa River, at a site which lies astride the Ontario Quebec boundary, where, forming part of a project for 280,000 horse power, eight units, aggregating 224,000, horse power, are being installed Other important schemes have materialised at the Upper Notch station on the Montreal River, belonging to the Canada Northern Power Corporation, at the Canyon on the lower Abitibi River, under the Ontario Power Service Corporation, and at High Falls, Michipicoten River, for the Algoma District Power Company

The Province of Quebec, with an increment of 122,700 horse power during the year, is a close second to Ontario The additions have been contributed by five organisations The MacLaren-Quebec Power Company has installed 90,000 horse power, out of a proposed 120,000 horse power development, on the Lievre River (Fig 2), and contemplates the construction of a second 120,000 horse power station near the junction of that river with the River Ottawa The Cedar Rapids Reservoir of 25 thousand million cubic feet capacity has also been brought into commission The Shawinigan Water and Power Company has added a 25,000 horse power unit to the plant at Grand'mère and is now supplementing the station at La Gabelle with a 30,000 horse power unit, both on the St Maurice River, farther up which an initial installation of 160,000 horse power is in hand at Rapide Blanc Smaller installations have been effected by the Lower St Lawrence Power Company and two other concerns

The Province of Quebec will receive a considerable augmentation of power in the near future when the undertakings of the Beauharnois Power Corporation on the St Lawrence River (200,000 horse power and ultimately 500,000 horse power), the Alcoa Power Company on the Saguenay River (260,000 horse power), and the joint development, above referred to, of the Ottawa Valley Power Company and the Hydro-Electric Power Commission of Ontario, on the Ottawa River, are completed The Saguenay River project at Chute-à-Caron is actually at the point of completion The

FIG 2 —High Falls development, Lievre River, Quebec (90 000 horse power) of the MacLaren Quebec Power Co (By courtesy of the High Commissioner of Canada)

AVAILABLE AND DEVELOPED WATER POWER IN CANADA JAN 1, 1931

Province	Available 24 hour Power at 80 per cent Efficiency		Turbine Installation (h p)
	At Ordinary Minimum Flow (h p)	At Ordinary Six Months Flow (h p)	
British Columbia	1,931,000	5,103,500	630,792
Alberta	390,000	1,049,500	70,532
Saskatchewan	542,000	1,082,000	42,035
Manitoba	3,309,000	5,344,500	311,925
Ontario	5,330,000	6,940,000	2,088,055
Quebec	8,459,000	13,064,000	2,718,130
New Brunswick	68,600	169,100	133,681
Nova Scotia	20,800	128,300	114,224
Prince Edward Island	3,000	5,300	2,439
Yukon and N W Territory	294,000	731,000	13,199
Totals	20,347,400	33,617,200	6,125,012

Note —' Ordinary Minimum Flow ' is based on the averages of the flows for the lowest two periods of seven consecutive days in each year, over the period for which records are available Ordinary Six Months Flow is based on the continuous power indicated by the flow of the stream for six months in the year The actual method to determine this flow is to arrange the months of each year according to the day of the lowest flow in each The lowest of the six high months is taken as the basic month The average flow of the lowest seven consecutive days in this month determines the ordinary six months' flow for that year The average of such figures for all years in the period for which data are available is the ordinary six months flow used in the calculation

Beauharnois project was referred to in NATURE of Dec 14, 1929, p 930, at the time of the inauguration of constructional operations by His Excellency the Governor General It is a most important undertaking, comprising an overland canal from the St Lawrence River, 15 miles in length, 600 ft wide, and 27 ft deep The canal will extend from its intake at Lake St Francis to a power house and locks at Beauharnois on Lake St Louis, where a direct fall of 83 ft will be obtained

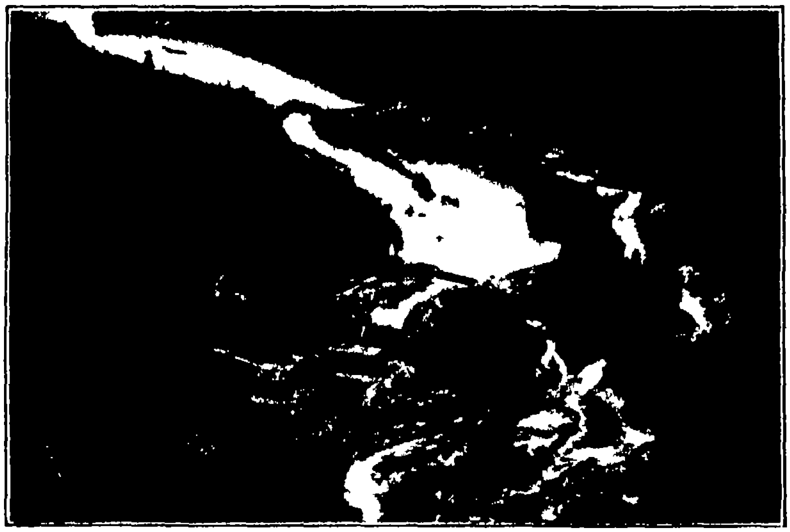

Fig 3 Aroostook Falls development Aroostook River, New Brunswick (11,400 horse power), of the Maine and New Brunswick Electric Power Co, Ltd (By courtesy of the High Commissioner of Canada)

The financial commitments in schemes of this magnitude are necessarily of a very high order In the aggregate, it is computed that during the past year a sum of no less than 80 million dollars (say £16,000,000) has been expended on programmes of construction at the various centres, and it is estimated that a further outlay of 300 million dollars (£60,000,000) will be incurred during the next two or three years More than 11,000 men are at present employed in actual constructional work *in situ*, in addition to a large army of operatives engaged at factories and elsewhere in producing material and equipments

There are many features of interest among the lesser undertakings, but space does not permit of reference to them A picturesque view of a relatively minor development in New Brunswick is shown in Fig 3

A substantial part of the Report on the Water Power Resources of Canada is devoted to a detailed account of the various ways in which the developed power is utilised The overwhelming bulk (85 1 per cent) is produced at central electric stations for general distribution for industrial, municipal, commercial, domestic, and agricultural use A much smaller amount (9 5 per cent) is directly applied to the power plants of pulp and paper mills, but this is scarcely a true index of the demands of this industry, by far the most important in Canada, since large quantities of electricity are purchased *en bloc* from the central stations The balance of 5 4 per cent is absorbed in general industrial undertakings, such as mines and mineral reduction works, electro chemical plants, saw and timber mills, machine shops pumping plants, and for electric railway operation The total water power installed at the present date works out at 617 horse power per 1000 of population, and places Canada in an outstanding position *per capita* among water-power using countries The capital so far invested is estimated almost to reach the startling figure of 1,390,000,000 dollars, or nearly £280,000,000

[1] Report No 1462 Hydro electric Progress in Canada in 1930 Report No 1474 Water Power Resources of Canada (Ottawa Department of the Interior, Canada Dominion Water Power and Hydrometric Bureau)

Work of the Medical Research Council

THE Report of the Medical Research Council for 1929–30 * indicates as usual the wide range of the researches carried out by members of its staff or by other investigators, assisted by grants The value of the funds available has been enhanced by the collaboration of various public bodies with the Council in specific schemes of research and by the facilities provided for investigations by university and other laboratories During the year, Sir Frederick Gowland Hopkins and Sir Charles Martin retired from the Council, and their places were filled by the appointment of Sir Charles Sherrington and Dr J A Arkwright

* Committee of the Privy Council for Medical Research Report of the Medical Research Council for the year 1929–30 (London H M Stationery Office 1931) Pp 138 2s 6d net

Clinical Research and Experimental Medicine

During the year, University College, London, established within its Hospital a Department of Clinical Research Sir Thomas Lewis was appointed as the first physician in charge of the Department on his resignation as a member of the ordinary staff of the Hospital He will continue, as before, to give whole time service to the Medical Research Council At Leeds, Birmingham, and Aberdeen, steps are being taken to provide full-time positions for clinical research At Aberdeen also, the professor of pharmacology is to be given charge of beds within the new Royal Infirmary, thus reproducing the conditions at

Sheffield, where Prof E Mellanby is both professor of pharmacology and a physician to the Royal Infirmary

Sir Thomas Lewis and his colleagues have studied Raynaud's disease they have shown that the malady is due, as Raynaud thought, to arterial spasm, and that the abnormal element in the reaction to cold is a direct reaction, due to a peculiar condition of the vessel wall, and is not the result of a reflex through the vasomotor nerves In further analysis of the reaction of the body to cold, they have shown that after a finger has been immersed in cold water for 5 10 min , a vasodilatation occurs which is due to an axon reflex in the sensory nerves This mechanism plays an important part in protecting exposed areas from excessive cooling and subsequent injury

BIOLOGICAL STANDARDISATION

The Council plays an important part in the development of methods of precision for the measurement of therapeutic agents which cannot be estimated by direct chemical means, in the preparation of standards of reference for these assays, and in the administration of the Therapeutic Substances Act The full value of this work is only attainable by international agreement, for which the League of Nations has set up a permanent International Commission on Biological Standards under the chairmanship of Dr Madsen Dr H H Dale, director of the National Institute for Medical Research, is the British representative on this Commission

The issues of samples of standards to licensees under the Therapeutic Substances Act numbered 190 500 samples of different substances were tested for the authority administering the Act A considerable number of these were samples of "sterilized surgical catgut", which was added to the schedule of therapeutic substances during the year A dried antiserum for, and suitable toxin of, *B Welchii* have been prepared and are available for issue whenever an international standard for the former has been defined

For the past sixteen years, all the toxicity and potency tests of samples of novarsenobenzene and sulpharsenobenzene have been carried out by members of the staff of the Institute The exact terms of the test can now be precisely defined and standards of toxicity and potency have been laid down by international agreement It was therefore found possible during the year to direct British manufacturers to perform the biological tests for themselves, so that the Institute will gain resources of time and material for progressive research in chemotherapy

A standard for vitamin D in the form of a solution of irradiated ergosterol was also made available during the year and supplied to twenty eight institutions in Great Britain and in eight other countries

INSULIN

Except for a few months immediately after its discovery, the supply of insulin has always exceeded the demand in Great Britain and has provided a growing export trade At the same time, the home demand has continually increased, for example, the consumption in 1930 was four times greater than in 1925 But even the present consumption corresponds with much less than the present number of diabetic patients in Great Britain, so far as that can be estimated Again, the proved benefit of insulin in the individual case is not reflected in the death-rates for diabetes as a whole, which have remained fairly steady since 1922 Both these facts suggest that insulin is being inadequately utilised

Analysis of the death rates, however, shows that at the earlier ages there has been a reduction since the introduction of insulin thus the mortality of males less than 55 years of age has been reduced by 37 per cent and of females by 21 per cent since 1923 Above 55 years of age, the death rate for males neutralises the earlier decrease and for females actually outweighs it The increase is evidently dietetic, since the mortality at these higher ages was greatly reduced during the War and it is in this type of case that insulin treatment is least frequently used

NUTRITION AND VITAMINS

The Council has arranged a trial, among Royal Air Force personnel, of the value of regular administration of vitamin A in the prevention of colds or other ailments during the winter months, and with the co operation of the medical staff of the London County Council, of its usefulness in the treatment of infective middle ear disease after scarlet fever, and in the prevention of dangerous sequelæ after the common infective fevers Prof E Mellanby and his colleagues have continued their work on the anti infective action of vitamin A it appears to improve the chances of recovery in puerperal fever, and also, administered prophylactically, to reduce the incidence and the severity of any infections which may develop They have also found that cereals, especially the germ, will produce degeneration in the spinal cord when the body is deprived of vitamin A, administration of the vitamin will bring about rapid improvement of function Vitamin A also prevents the neurological changes found in 'ergotism'

The pure substance carotene has both the growth promoting and anti infective properties of vitamin A, although chemically it is an entirely different compound Moore has shown that when carotene is given to rats, large quantities of vitamin A, detected by colorimetric and spectroscopic tests, can be found in their livers, indicating that carotene is converted to vitamin A in the body (see *Biochem Jour*, vol 23, p 1267, 1929 vol 24, p 692, 1930)

Chemical studies of vitamin D have been continued by Bourdillon and Webster and their colleagues The mixed products of the irradiation of ergosterol have been fractionated by distillation in a high vacuum Partial destruction occurs, but a fraction of high activity can be obtained and,

from this, active crystalline products, but the potency is not high enough to justify the supposition that the vitamin is present in pure form Evidence has also been obtained that at least one other substance is formed as a primary irradiation product of ergosterol with the vitamin D

Vitamin deficiencies have been found to have effects upon the heart Carter and Drury found that bradycardia and heart block occurred in pigeons fed on polished rice Drury, Harris, and Maudsley observed a bradycardia in rats fed on diets deficient in vitamin B, which differed from the former type in being of sinus origin and not due to vagal influence

Mackay has found that anæmia is common in artificially fed, and to a less extent in breast-fed, infants, and is due to a deficiency of iron The anæmia diminishes resistance to infection and retards growth It can be prevented, and the morbidity rate simultaneously reduced, by administering a suitable form of iron salt

Miss Durham has now completed a prolonged experiment upon the effects of alcohol on the fertility of guinea pigs and on their offspring No deleterious effects whatever were observed the litters obtained from alcoholic parents, or from their descendants, were as numerous and as heavy as those from control matings and showed no excess of still births or deformities No transmitted defects were observed These results therefore fail to confirm those obtained by Stockard and published in 1913

Hormones

Dale and Gaddum have investigated the contractures of voluntary muscles, deprived of their ordinary motor nerve supply, which are elicited by stimulating the nerves which cause dilatation of their small arteries The muscles also react, by contractures, to the injection of chemical substances, of which acetylcholine is the most potent It appears almost certain that the nervous stimulation liberates acetylcholine and that the contracture is really due to the action of this substance upon the muscle fibres Eserine enhances the action of acetylcholine Matthes has found this effect to be due to the inhibition of the blood esterase, which hydrolyses it

Drury has continued his work on muscle adenylic acid and yeast adenosine both powerfully dilate the coronary arteries of the heart Adenosine may have a therapeutic value as a vasodilatant, since it is nontoxic

Marrian has continued his work on the chemistry of oestrin it can be readily extracted with ether from acidified urine obtained from pregnant women and purified by saponification and fractionation with solvents (see *Biochem Jour*, vol 23, p 1233, 1929 vol 24, pp 435, 1021, 1930) The crystalline substance has a very high activity

Gaddum has shown that a relatively simple polypeptide containing thyroxine, isolated from the thyroid gland by Harington by treatment with digestive enzymes, is as effective as *l* thyroxine when injected subcutaneously into the rat, but much more effective than the latter when both are given by the mouth

Pathological Researches

In conclusion, brief reference may be made to a few of the numerous researches of a pathological or bacteriological nature A report by the Departmental Committee of the Ministry of Health, on maternal mortality and puerperal fever, with which the Medical Research Council has been collaborating, has shown that 40 per cent of deaths are due to septic infection, 20 per cent to toxæmias, and 40 per cent to various accidental causes The prevention of the latter needs the better application of known means, our knowledge of the toxæmias is still imperfect, but administration of large doses of alkalis has been found to have a beneficial effect in the renal complications of pregnancy Research on the organisms responsible for puerperal fever and on methods of prevention and treatment is being actively pursued, and will be assisted by the building of a special block for septic cases at the new Queen Charlotte's Hospital at Hammersmith

Dunkin and Laidlaw have continued their work on canine distemper A method has been devised for measuring the progress of antibody production, the antiserum will fix complement in the presence of the virus, *in vitro*, and the reaction may be a means of estimating the potency of the virus or of the antiserum Durable immunity to the disease can be produced by injecting the serum and the virus at the same time into another part of the body, so that the whole process of immunisation can be performed on a single occasion

Dobell has completed some prolonged studies on the *Entamœba histolytica*, the cause of amœbic dysentery in man The organism can now be maintained indefinitely in artificial culture and any stage in its life history can be produced at will, it can be inoculated into a macaque monkey and the infection eradicated at will by therapeutic means Conditions affecting either host or parasite separately, or both, together can therefore be studied in detail these researches should pave the way for a really efficient treatment or prevention of the disease in human beings

The Paris Observatory.

It has been decided to close the Paris Observatory and erect a new national observatory at a cost of £400,000 in the Durance region of Provence, retaining the old building as a repository for equipment not in use and the many historic instruments the Observatory possesses It is many years since the proposal to remove the Observatory was initiated, and the present decision has been taken mainly on account of the difficulty of carrying on observations, due to the prevailing atmospheric conditions and to the vibration caused by the heavy volume of motor traffic in the neighbourhood

Though the decision is undoubtedly a right one,

many will regret the passing of an institution which has played a prominent part in the scientific life of the French capital Situated about half a mile south of the Luxembourg, the Observatory was built in the reign of Louis XIV to the designs of Claude Perrault, the famous architect of the Louvre It was begun in 1667 and completed in 1671—four years before the erection of Greenwich Observatory—and Dominique Cassini, the Italian astronomer, was appointed the first superintendent

In spite of the eminence of its designer, the building was not well adapted for its purpose, for as Grant says, "No means were provided in the construction of the building for enabling the astronomer to observe the celestial bodies at all altitudes, by means of instruments sheltered under its roof, nor was it possible to repair the omission, on account of the enormous thickness of the walls" Neither was its organisation one which was likely to lead to the best results Though Cassini was appointed its nominal head, no fixed sum was set apart to provide for the annual maintenance of the establishment No definite plan of observation was drawn up, and the Observatory was available for other astronomers desirous of prosecuting their own lines of study Cassini began his observations at the Observatory on Sept 14, 1671, Picard his on July 9, 1673, and La Hire his in 1677 Six years later a mural quadrant of 5 ft radius was installed and with this instrument La Hire made meridional observations for thirty years Four Cassinis in all were successively at the head of the Observatory, their combined periods of office extending over a hundred and twenty years

With the nineteenth century many changes were introduced, and the Paris Observatory has had a succession of directors whose names have become household words From 1830 until 1853, Arago was the director, but it was his successor, Leverrier, who became the real organiser of the Observatory Newcomb, who stayed in the Observatory as a guest of Delaunay during the Commune in 1870, said Leverrier's work 'was not dissimilar to that of Airy at Greenwich, but he had a much more difficult task before him, and was less fitted to grapple with it" Early in 1870, Leverrier indeed had become so unpopular that he was removed from office, but in 1872, on the tragic death of Delaunay, he was reappointed director He continued to hold office until he died in 1877, and for many years his statue has stood in the Cour d'Honneur

The reputation of the Paris Observatory has been raised still higher under the regime of Leverrier's successors, Mouchez, Tisserand, Loewy, and Baillaud, who, as Newcomb remarked in his "Reminiscences of an Astronomer", "have known where to draw the line between routine on the one side and initiative on the part of the assistants on the other" The pages of Nature have frequently contained notes on the progress of work carried out at the Observatory

Obituary

Prof Otto Wallach

In Otto Wallach, German chemistry loses one of its organic pillars He is almost the last to go of a great generation which believed in the serious study of materials at the laboratory bench as the prime and proper occupation of the chemist and could express itself in plain, straightforward, honest language, free from illusions and pretence The split *p* and the proton leaning post have changed all that the beginner no longer learns even to determine the molecular weight of oxygen, although he is prepared to discuss the 'in'ards' of its atoms, analysis is a meaningless word to him, he is not really to be trusted to analyse anything, either by word or deed What was a moral science is fast becoming mere superstition to the majority The example of a craftsman like Wallach is therefore of special value Devoting himself to the study of one of the great groups of plant products, the essential oils, he developed consummate analytical skill in unravelling Nature's most tangled mixtures, thus laying not only foundations for the future study of vital products but also contributing largely to the development of a most remunerative industry

Wallach was born on Mar 27, 1847, at Königsberg, Prussia, he died on Mar 1 Educated at a humanistic gymnasium in Potsdam, his university studies were carried on at Gottingen, where he came under Wohler, probably a greater chemist than his partner, Liebig, Fittig, a most accurate but unimaginative worker, and Hübner, a man of lesser note, he then spent a term in Hofmann's laboratory in Berlin After taking his degree in Gottingen in 1869, he passed the winter in Berlin as assistant to Wichelhaus, becoming assistant to Kekulé in Bonn in the spring of 1870 Part of 1871 was spent in the Berlin Aktiengesells für Anilinfabrikation In 1872, he returned to Bonn as laboratory assistant He became a *Privat-Docent* in 1875 and *extraordinarius* in the following year Thirteen years later, he succeeded Victor Meyer at Gottingen

Wallach's career therefore was neither adventurous nor rapid He began his work on essential oils in 1884 His industry so impressed the electors that, in 1910, as all good German chemists do, he received a Nobel Prize If an infinite capacity for taking pains be the mark of genius, he was definitely a genius, if imaginative power and a developed artistic and critical sense be the criteria, he was simply a highly competent workman a good cook, able to serve up dish after dish in well garnished form, scarcely a *chef* of high degree He was not even a pioneer but took up the ball, at a propitious moment, when the development of structural and synthetic chemistry was in

full swing and help was coming in from every quarter following it closely, happily aided by the inspired action of men like Tiemann and Baeyer, who every now and then gave to it a guiding kick, he was able to carry it forward with ever growing advantage, the score of papers to his record being ultimately 179

The first foundations of terpene chemistry were laid in France, especially by Berthelot Gladstone and Wright were early in the field here but did not get very far In the early 'seventies, Tilden and I began to revise and extend the French work but the real cause of advance was Tilden's brilliant discovery of the beautifully crystalline nitrosochlorides and nitroso derivatives of turpentine (pinene) and citrene We were early convinced that the number of isomeric hydrocarbons had been greatly exaggerated Wallach began by studying wormseed oil but soon passed into our field—without ever asking our permission, although those were days when not all were pirates as now He scored his first real success in working with Tilden's compounds It was therefore amusing when, in 1890, in a paper in the *Annalen* he practically accused me of having picked his brains when I had visited his laboratory shortly before This was in connexion with sobrerol As a matter of fact, I had been collecting the material a dozen years previously it was in this work that Sir William Pope's crystallographic genius first became apparent

If we ask why Tilden, who made so brilliant a beginning, did so little afterwards, whilst Wallach who had trod in his footsteps did so much the answer is that in 1880 Tilden became the head of a new school (Mason College) and had 'fish to fry' more important than essential oils Wallach had not a few helpers, under the German university system The last thing Birmingham cared for then was research Tilden had scarce a student to work with him his men were under no Ph D compulsion to attempt original work I was in a like position and, at about the time Wallach began, had three new laboratories on my hands in rapid succession Still we kept the camphor pot boiling usefully, so that an English camphor school gradually arose, this began by doubting Kekulé Perkin junior's synthetic terpene work stands unrivalled Later English workers in the field have given proof that there are still craftsmen among us Maybe, ere long we shall have to show that not a few of the conclusions of the Wallach school are unsound

Wallach was able to accomplish his work because he was under conditions which were the outcome of centuries of loving care for the universities and a public belief in the value of education Here, fifty to sixty years ago, even Oxford and Cambridge were scarce known to natural science Cambridge came fairly rapidly to the fore but Oxford was slower Meanwhile schools of university rank have been established in every considerable town in the country, perhaps some of us who have contributed to this end may prove to have done work of far more value than that on essential oils

Henry E Armstrong

We regret to announce the following deaths

Mr T C Cantrill formerly of the Geological Survey of Great Britain on April 3, aged sixty three years

Sir John de Villiers, noted especially for his work while in charge of the map room at the British Museum and his contributions to geographical and historical literature, on April 2, aged sixty seven years

News and Views

The Society for the Preservation of the Fauna of the Empire performed a great service when it persuaded the Secretary of State for the Colonies to approve of and support a general survey of the East African group of Colonies and Dependencies from the point of view of the preservation of wild life A fortunate choice selected as observer Major R W G Hingston, already well known for his natural history observations, and after a rapid survey of the land, the results and conclusions of his tour were presented on Mar 9, in the form of a lecture to the Royal Geographical Society Major Hingston had the advantage of discussing with Government officials and representatives of public opinion the problems which face the fauna of Africa, and on the basis of these discussions and his own observations he has submitted for the consideration of H M Government a scheme of nine national parks, which, if brought into being and effectively conducted, would ensure the perpetual preservation of the fauna of these territories, without undue interference with native rights or economic development To anyone familiar with the history of wild life in Africa, the gradual but constant retreat and often final extermination of the large animals is a commonplace, but surely Major Hingston exaggerates when he states that "great and small, everything is retreating" The general experience is that cultivation of the soil *increases* the amount of wild life, only, the great animals go, and the small things that take their place, even if they do not become pests, far from compensate for the picturesqueness of the departed

The large animals are at the mercy of several disruptive forces Of these, man has brought into play cultivation of the soil, the demands of special trades, and the activities of sportsmen, while Nature threatens with epidemic diseases Not only has African wild life suffered directly from such diseases, but the suspicion that it may harbour or encourage diseases to which man is subject has concentrated a new warfare against it, so that last year 20,000 head of game, including 9000 zebra and 2500 wildebeest, were slaughtered in Zululand because it was feared that they kept alive the tsetse fly with its burden of sleeping-sickness National parks and game reserves at present help to preserve the wild life of Africa, but the perma-

ience of the latter is uncertain, since their establishment or dissolution depends simply upon a proclamation in the local Government *Gazette*, agreed to by the Secretary of State. National parks, on the other hand, are more stable, made by Act of Parliament the property of the public for ever, to be utilised for the sole purpose of preserving the natural objects within them. "It is the belief", declared Major Hingston, "of all who desire the perpetuation of the fauna, that national parks on this rigid basis should replace the fluid reserves." Accordingly, he describes a series of nine national parks ranging from South Central Africa to the gorilla territory of Uganda. It is important that these parks should be created before wild life approaches the stage of disappearance. Not only will delay make them less effective for their prime purpose, but also it will add to the difficulties and cost of establishing them.

OF the many inventors from whose work has gradually been evolved the modern safety bicycle, James Starley, the centenary of whose birth occurs on April 21, was one of the most successful. By his improvements, it has been said, he rendered bicycles and tricycles machines capable of general use, while to his perseverance and energy Coventry owes its position as the centre of the cycle industry. The son of a Sussex farmer and born at Albourne, he began work on the land at the age of nine and at fifteen was a gardener in the employ of the famous marine engineer, John Penn, at Lewisham. A born inventor, he abandoned gardening for mechanics, and first in High Holborn and then in Coventry was employed in the manufacture of sewing machines. On the introduction of the French 'boneshaker' bicycles into Great Britain in 1868, their manufacture was taken up by the Coventry Machinists' Company, in which Starley was a foreman, and by him quickly improved. Patenting a method of tightening the wire spokes of tension wheels, in 1870 he brought out the "Ariel" bicycle, the first attempt to produce a light all-metal machine, and from this sprang the well-known 'ordinary' or 'penny farthing' bicycle. Starting in business for himself in 1872, he quickly gained a reputation for his machines and became known as the 'Father of the Bicycle'. He died on June 17, 1881, at the early age of fifty years, and was buried in the Cemetery, Coventry. Three years later, a monument was erected in Queen's Road bearing his portrait and representations of some of his machines. His nephew, J. K. Starley, also made notable improvements on bicycles, and in 1885, with Sutton, brought out the "Rover" bicycle, which embodied most of the features of the present safety machine.

AN exhibition of British glass and glassware was held in the exhibition hall of Messrs. Selfridge and Co., Ltd., Oxford Street, London, April 13–18. The exhibition was organised by the Glass Manufacturers' Federation in order to indicate to the general public the variety and quality of the products of the glass industry. The exhibits included artistic glassware and fine crystal tableware; glass bottles and jars of various shapes and sizes; sheet glass in different forms and plate glass from ⅛ inch in thickness to 1½ inch; glass transparent to ultra-violet light, and glass which excludes about 80 per cent of the heat rays. The varied range of exhibits of chemical, scientific laboratory, and medical glassware, and of fused silica glassware, gave evidence of the remarkable progress that has been made in these branches of the industry. The application of glass in the electrical industry was illustrated by wireless valve bulbs; electric lamp bulbs, which are produced by automatic machinery; a 10 kw. electric lamp, such as is used in lighthouses and in aerodrome pilot lights; photo-cells; and neon lights for decorative and publicity purposes. Two large blocks of fine optical glass were shown, and also a polished telescope disc of 24 inches diameter. Amongst the spectacle lenses exhibited were samples of specially computed cataract lenses of light weight, and trifocal lenses made by fusing as many as six pieces of glass to form the complete lens. Spun glass, known as glass silk or glass wool, was shown in skeins and also woven into cloth and mats. This is now being largely manufactured and used for heat insulation purposes on boilers and steam pipes. It is more efficient than many other substances used for this purpose, and, in the form of mattresses or strips, can be easily and quickly applied or removed.

AT the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on April 13, the finance report showed that, including the grants approved at the meeting, the Campaign had now subsidised research centres and independent research workers, since its inception, to the extent of £157,000. Apart from this, a sum of more than £500,000 had been subscribed and is being administered by the branches and affiliated organisations of the Campaign throughout the British Empire. On the recommendations of the Executive Committee, the Grand Council approved the following grants: £2500 to the Cancer Hospital (Free) for its general research work, together with an additional sum of £500 to meet the expense incurred by the Research Institute by the appointment of its bio-chemist, Dr. J. W. Cook; £650 for one year to St. Mark's Hospital, City Road, and £2500 to St. Bartholomew's Hospital. For the sixth year in succession, the Grand Council renewed the grant of £680 to the Medical Research Council towards the upkeep of the Radon Centre at the Middlesex Hospital, which supplies a number of organisations with radon for scientific experimental investigations. Prof. W. S. Lazarus-Barlow was elected to fill the vacancy in the five nominees of the Campaign on the Scientific Advisory Committee, the other five members of which are nominated jointly by the Royal Society and the Medical Research Council. The Grand Council acceded to the request that the Glasgow Royal Cancer Hospital should be affiliated officially to the British Empire Cancer Campaign.

THE "Unusual Ice Formation" described by Prof. A. Morley Davies in NATURE for Mar. 7, p. 340, has also been recorded by Mr. W. B. Alexander at Reigate on the morning of Jan. 2, 1931. The latter formation consisted of a pencil-shaped column of ice 3¾ in. high

and ⅜ in in diameter, rising vertically from a glass bowl about 4 in in diameter and containing nearly 2 in of water A similar phenomenon, illustrated by a very fine photograph, was described by Mr Basil Longley, of Crawley, Sussex, in the *Meteorological Magazine* for March 1929, and there are probably other descriptions extant In all these cases the method of formation was probably along the lines described by Prof Davies Mr Longley explains it as follows "the water froze rapidly on top, and when the expansion took place underneath, the surface ice broke (this can be seen) and owing to the continuing pressure of the water expanding, it gradually oozed out, freezing as it came There was a tiny hole up the centre of the column which justifies this theory " The volume of Mr Longley's column was, roughly, one hundredth of the ice in the bowl, of Mr Alexander's about one sixtieth, and of Prof Davies' (if it was solid) about one fifteenth , the expansion of water in freezing is about one tenth, but the formation of the columns could not begin until a fair thickness of ice existed on the surface The order of magnitude is approximately correct, but the formation evidently requires a high degree of cohesion between the ice and the sides of the bowl, as well as certain definite conditions of temperature, thus accounting for its rarity

A NEW record for a long distance flight in a light aeroplane has been set up by Mr C W A Scott, who left Lympne aerodrome on April 1 and arrived at Darwin, in the Northern Territory, Australia, on April 10 His time for the journey was 9 days 3 hours 40 minutes, thus beating Air Commodore Kingsford Smith's time for the same flight last autumn by about nineteen hours Mr Scott's machine is a Gipsy Moth light aeroplane, specially fitted with fuel tanks carrying about a third of a ton of petrol, and the engine is a de Havilland 120 h p Gipsy II , the same pattern as that used by Kingsford Smith Its cruising speed is about ninety miles an hour According to a long communication from Mr Scott in the *Times* of April 11, his course was from Lympne across Europe to Belgrade, on to Aleppo, then to Baghdad, Gwadar in Baluchistan, Karachi, Calcutta, Rangoon, Singapore, Bima, and then across the Timor Sea to Bathurst Island and Darwin His longest day was 15 hours 45 minutes, covering 1450 miles, and total flying time and distance, 109 hours 50 minutes and 10,450 miles That the aeroplane successfully withstood the strain of this flight must be very gratifying to the designers and makers of both engine and machine, while the flight itself is a noteworthy feat of personal endurance and skill

IN a paper read before the New York Electrical Society on Mar 19, Dr Goldsmith discussed what he calls the "new music of electric vibrations" He illustrated it by a novel device called the electric carillon, which can send out bell tones louder than any bell in the world A series of small steel chimes not unlike those of a household clock are struck by little electric hammers actuated by a keyboard similar to that of a piano The sounds thus produced are only audible a few inches away but the vibrations of the steel chimes create small electric currents in devices like the 'pick up' used in electric gramophones These feeble currents are amplified millions of times by vacuum tube amplifiers and can be clearly heard in the largest concert hall or for miles round a church tower by means of giant amplifiers The operator of the electric carillon not only controls the notes to be played but also can vary the volume of the tone to any desired extent Dr Goldsmith believes strongly in the future of electric music In his opinion, the musical artist of the future will become more and more indispensable The physical limitations which now weigh heavily on great artists will be largely reduced The number of notes which the musician can play per second will not be limited by the speed of his fingers T[illegible] of any origin can be made to resemble those of [illegible] desired instrument by electrical methods Each musician will be able to play not only the melody but also will be able to make it sound as if produced by any type of instrument The new electric music will gradually evolve a new type of composer capable of utilising to the full the capabilities of emotional expression contained in electric music Dr Goldsmith also demonstrated the 'theremin ', an electric musical instrument which is operated by moving the hands backwards and forwards in front of it It is called the theremin, after its inventor, a Russian physicist

In the *Engineer* of Mar 27, Mr H J Shepstone gives an account of the progress made with the scheme for supplying Palestine with electricity, generated in the valley of the River Jordan In its passage from its source in Mount Hermon to the Dead Sea, the river has a fall of no less than 3000 ft , and it discharges more than 5,000,000 tons of fresh water into the Dead Sea daily The entire scheme includes the provision of three hydro electric plants, the first of which has just been completed This station is situated at Jisr el Mujameh, some seven miles south of the Sea of Galilee For the storage and control of the water two dams and two concrete lined canals have been constructed and the first two units of 8000 h p each have been installed in the power-house When the demand warrants it, two other units will be installed, while later on a second power-house will be built at Abadieh and a t[illegible]rd at Jisr Banah Yakoub, which lie respectively south and north of the Sea of Galilee Transmission lines will connect the hydro electric plants with three fuel power stations at Jaffa, Haifa, and Tiberias, and in the near future, it is hoped, every city, town, and agricultural settlement will be able to obtain electrical energy

SMUT diseases, bunt of wheat in particular, are responsible for considerable loss of grain in England, and the illustrated bulletin (No 24) recently issued by the Ministry of Agriculture entitled "Cereal Smuts and their Control" should prove of great benefit to the farmer The symptoms and mode of infection of these diseases in wheat, barley, and oats are described, and methods of control, fairly simple to carry out and of moderate cost, are given in detail,

Attention is directed to the necessity for distinguishing between 'covered' and 'loose' smuts, for whereas in the former, contamination with the fungus is on the outside of the grain only, in the latter the infection is internal, and the appropriate methods of control are accordingly different in the two cases. For prevention of 'covered' smuts, of which bunt in wheat is an example, treatment or 'pickling' with formalin (1 pint of 40 per cent formaldehyde to 40 gallons of water) is recommended as preferable to the older method of steeping or spraying with copper sulphate. The advantages afforded by a dry type of treatment are obvious, and mention is made of recent successful trials of powder pickling with copper carbonate. The control of 'loose' smuts offers a much more difficult problem, as external application of a fungicide is useless. Steeping the grain in hot water appears to be the only known remedy, but the temperature necessary to kill fungus is very close to that fatal to the grain, so that the method is attended with considerable difficulty. Copies of the bulletin may be obtained from the Ministry of Agriculture, 10 Whitehall Place, London, S.W.1. Price 5*d*. post free.

PRELIMINARY reports on the work of the expedition of the Royal Anthropological Institute to Kharga Oasis, organised and led by Miss Caton Thompson with Miss E. Gardiner as geologist, justify the choice of this little explored area as the scene of the past season's work, and hold out strong hopes for the future. Thanks to the co-operation of Lady Bailey, and with the permission of the Egyptian and British Governments, an aeroplane and air photography were at the disposal of the expedition for a period of two weeks. By this means and with the additional assistance of camel transport, it was possible to examine the area thoroughly, and points of archæological importance were marked down for future seasons' investigations. In addition to the work of reconnaissance, the history of the springs of the floor of the oasis was investigated. This brought to light a deeply buried Mousterian culture of special ised type, showing affinities with cultures in Algeria and Tunisia. Another notable find was extensive flint workings, extending for some miles along the edge of the Kharga Scarp, the second only of its kind to be found in Egypt. A short account, with illustrations, of the results appeared in the *Times* of April 13.

THE *Polar Record*, of which the first number has just appeared, is a modest journal which it is proposed to publish twice a year from the Scott Polar Research Institute at Cambridge (price 1*s*.). It is to be the official organ of that institute, and though at present merely a record of news of exploration in polar regions, it is hoped gradually to extend its scope. The first number starts well and should be full of interest to that small but growing group of explorers and students of polar regions. News is given of Norwegian work in Svalbard, Russian in Franz Josef Land and Northern Land, and German, British, American, and Danish in Greenland. There are also some details of American, Norwegian, and British work in the Antarctic, where important discoveries have been made during the last few months. The number concludes with a short bibliography of recent polar books.

THE issue of the two index numbers of *Science Abstracts* completes the physics and the electrical engineering sections of volume 33 (1930). More than 200 periodicals are abstracted by 76 abstractors, most of whom are specialists in the particular branch of the subject with which they deal. The physics volume has 4165 abstracts of average length 0.267 page, and 230 pages of index; the electrical engineering volume, 2537 abstracts of average length 0.282 page, and 134 pages of index. The volumes are essential in every library consulted by physicists or electrical engineers who desire to keep themselves up to date.

AT the annual meeting of the Gilbert White Fellowship held on April 11, Sir John Russell was elected president and Prof. E. J. Salisbury and Prof. W. H. Wagstaff were elected vice-presidents.

A MEMORIAL to Admiral of the Fleet Sir Henry Jackson, which has been placed in the crypt of St. Paul's Cathedral, was unveiled and dedicated on April 13. It is in the form of a tablet, recording the principal posts he hold and referring to the services he rendered to the Navy. Sir Henry's scientific work was described in an article in NATURE of Jan. 11, 1930. His chief work was a pioneer investigation into problems connected with the transmission of signals by wireless telegraphy, a piece of research inspired by some experiments by Sir Jagadis Chunder Bose on coherers. Under Sir Henry's personal supervision, this type of communication was installed throughout the Navy.

AT the annual election of office-bearers of the Royal Philosophical Society of Glasgow, on Mar. 25, the following officers were elected: *President*, Prof. W. R. Scott; *Vice-President*, Dr. J. W. French; *Hon. Treasurer*, Sir John Mann; *Hon. Librarian*, Dr. J. Knight; *Hon. Auditors*, Mr. John J. D. Hourston and Mr. James A. French; *Acting Secretary*, Dr. James M. Macaulay. During the session, Sir Donald MacAlister, chancellor of the University of Glasgow, Sir C. V. Raman, professor of physics in the University of Calcutta, and Prof. F. O. Bower, emeritus professor of botany in the University of Glasgow, were elected honorary members of the Society.

ACCORDING to a notice issued (in Latin) from the Vatican City on Mar. 15, the Pontifical Academy of Sciences (Nuovi Lincei) is inaugurating the broadcasting of notes and information on mathematics and the experimental sciences and their applications. In general, the language used will be Latin, but for notes referring to investigations or discoveries the author's own language may be employed, and for matters of great importance other languages may be utilised. A general invitation to supply material for this purpose is expressed, and all communications submitted will be considered by a committee of the Academy. Notes giving the results of scientific work should consist of about 300 words, and items of

information of about 100 words Communications should be addressed "Pontificia Academia Scientiarum Comitatui pro Nuncio Radiophonico, Città del Vaticano"

At a meeting of the Council of the Royal College of Surgeons on April 10, the Jacksonian Prize for 1930 was awarded to Mr Edgar S J King, of the University of Melbourne, for his essay on "The Pathology of Ovarian Cysts and its Bearing on their Treatment" A certificate of honourable mention for an essay on the same subject was granted to Wilfred Shaw, of St Bartholomew's Hospital The John Hunter Medal and Triennial Prize for 1928–30 was awarded to Mr Layton, of Guy's Hospital, for his contributions to otology and for his valuable services to the museum, particularly in connexion with the Onodi Collection The Walker Prize for work on the pathology and therapeutics of cancer for 1926–30 was awarded to Sir G Lenthal Cheatle The Cartwright Prize for 1926–30 was awarded to Mr F W Broderick for his essay on 'The Etiology Pathology, and Treatment of Chronic General Periodontitis (*Pyorrhea alveolaris*)'

The twenty first annual May Lecture of the Institute of Metals will be given on Wednesday, May 6, by Mr William B Woodhouse, engineer and manager of the Yorkshire Electric Power Company, on "The Progress of Power Production" Tickets for the lecture may be obtained from the Secretary of the Institute of Metals, Members' Mansions, Victoria Street, London, S W 1 The autumn meeting of the Institute of Metals is to be held in Zurich on Sept 13–18 by kind invitation of the Schweizerische Verband fur Materialprufung The evening of Sept 13 will be devoted to the formal opening of the meeting, addresses of welcome by the inviting body, and the Autumn Lecture, to be given by Mr U R Evans, on "Thin Films on Metals in Relation to Corrosion Problems" The mornings of Sept 14 and 15 will be devoted to the reading and discussion of papers, whilst for the afternoons visits have been provisionally arranged to works in Zurich and its neighbourhood On Sept 18 the main party will divide, one part going to Biel to visit a watch factory and leaving for England in the evening, whilst the other will go via Lotschberg to visit the new aluminium alloys rolling mills at Chippis Siders, in the Rhône Valley From Chippis the party will either return to London via Lausanne or Geneva, or proceed via the Simplon to Milan to take part in the International Foundry Exhibition and Congress, which continues at Milan until Sept 27 The first congress of the New International Association for Testing Materials is being held at Zurich during the week preceding the Institute of Metals meeting

We have received from Messrs A Gallenkamp and Co, Ltd, Sun Street, London, E C 2, their catalogues of electrochemical apparatus and colorimeters (Lists No 80c and No 92) In the former will be found listed apparatus for electro analysis, the electrometric determination of hydrogen ion concentrations, and the measurement of conductivity of electrolytes Ammeters, voltmeters, galvanometers, and thermostats are included In the section on hydrogen ion concentration, a useful summary is provided of the use of the hydrogen electrode, with descriptions of other types, including the quinhydrone and glass electrode In the second list, numerous types of both simple and more complicated colorimeters are detailed, including two modern patterns of the Lovibond tintometer The catalogue gives a good idea of the range of instruments of this type which are at present on the market, and should be of use to biochemists and physiologists

A short but useful list of scientific journals and transactions of learned societies has just been issued by Messrs Oppenheim and Co (Rare Books), Ltd, 317A Fulham Road S W 10 In several cases complete sets are offered for sale

Librarians and others interested in the Far East should obtain a copy of Catalogue No 534, "Orientalia", just issued by Francis Edwards, Ltd, 83 High Street, Marylebone, W 1 Particulars of upwards of 1000 works are given in it relating to Burma, Ceylon, China, the East Indian Archipelago, Formosa India, Japan, Korea, Persia, Siam, Tibet, and general works

A good catalogue (No 364) of second hand books upwards of 2000 in number, has just been published by Messrs W Heffer and Sons Ltd, Petty Cury Cambridge It ranges over the subjects of agriculture botany, anthropology and ethnology, chemistry and chemical technology, mathematics, physics and engineering, physiology, anatomy and medicine, zoology and biology, and is strong in journals and other publications of learned societies

Applications are invited for the following appointments, on or before the dates mentioned —A senior secretary in the Matriculation and School Examinations Department of the University of London—The Principal ("M S E"), University of London South Kensington, S W 7 (April 25) A master under the Education Department of Southern Rhodesia to teach physics and chemistry at the Boys High School, Umtali—The High Commissioner for Southern Rhodesia, Crown House, Aldwych, W C 2 (April 30) A chief inspector of smoke nuisance under the Government of Bengal—The High Commissioner for India, General Department, India House Aldwych, W C 2 (April 30) Two fellows in psychiatry at the London Child Guidance Clinic, 1 Canonbury Place, N 1—The Secretary, Child Guidance Council 7 Buckingham Palace Gardens, S W 1 (May 2) An assistant lecturer in chemistry at the Liverpool Central Municipal Technical School—The Director of Education, 14 Sir Thomas Street, Liverpool (May 2) An assistant lecturer in physics at the University College of North Wales, Bangor—The Registrar, University College of North Wales, Bangor (May 16) A director of the Rubber Research Institute of Ceylon—The Chairman of the Board of Management, Rubber Research Scheme, Peradeniya, Ceylon (May 30) A lecturer in tinctorial chemistry and dyestuffs at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (June 5)

Research Items.

Daggers with Inlaid Handles.—In *Ancient Egypt*, 1930, No. 4, Sir Flinders Petrie, referring to the recent discovery in Palestine of two examples of the dagger having a metal handle cast in one piece with the blade and bearing a plate of inlay on each side, reviews a number of examples of the type which have come into view, in various countries. These he places in six classes: (1) The butt handle, of the simplest type, with a slight curve at the end and the inlay space shallow and long. It begins about 2000 B.C. near Behistun and is found at Nineveh and Ras Shamra. (2) The pommel type, begins with the butt getting wider as in Egypt; the distinct pommel appears in the south west of the Caspian; the fully developed pommel is on a dagger of Apepa III (1600 B.C.); the subjects are embossed on electrum plates. This type belongs to North Syria and was brought to Egypt by the Hyksos. (3) The encased handle begins with the deep setting of the handles as from Kasbek, Caucasus, about 600 B.C. The examples point to a primitive type of pierced bone handle. The encased inlay passed into a form like that of the deeply winged palstave. (4) To give the best grip to the handle for an upward thrust, a cusp was raised, giving the thumb and finger a more secure hold. A preliminary form appears in Hyksos times. It was a development of the tang made in shovel form to insert in a separate handle. (5) The wide blades with cross head handles are western. The inlay is riveted on. An example of about 1400 B.C. is from Korinth, others from Knossos, Veii, Cuma, and Terni. (6) The falchion (*khepesh*, the thigh), of eastern origin, an example from Diarbekr, of 1300 B.C., has an inlay handle with the name of Hadadnirari, and another of the time of Rameses II from Tell Retabeh.

Samoan Culture.—A detailed and exhaustive analysis of the material culture of Samoa by Te Rangi Hiroa (P. H. Buck) appears as *Bull.* 75 of the Bernice P. Bishop Museum of Honolulu. The summary of conclusions drawn is that canoes with top sides or planks joined by right through lashing associated with the rectangular house with wall posts and wall plate erected before the principal rafters were put up, the bow and arrow, slings, and such games as dart slinging, bowling with discs, and string figures constitute an early culture which spread over the whole Polynesian area. Certain culture traits such as the marae, stone figures, upright drums, and the nose flute passed into eastern Polynesia without affecting Samoa. The striking features distinguishing Samoan culture from the general culture of eastern Polynesia are the arched houses and the flanged plank canoes. Special efforts resulting in improved technique are closely related with class distinctions. Building and tattooing obtained their highest remuneration from the higher classes and these crafts were used to accentuate class distinction. The builders' guilds had more set rules than they had in eastern Polynesia. The Samoan system demands instant payment and immediate provision of food, as against the usual Polynesian system of reciprocal labour. Samoan material culture is uninspired.

Experimental Studies of Dengue.—Dengue is an acute, but benign, fever of 2-7 days duration and prevalent in the east. In the Philippines, the disease has recently been the subject of investigation by Majors J. S. Simmons and J. H. St. John, of the Medical Corps, and Captain F. H. K. Reynolds, Veterinary Corps, U.S. Army (*Philippine Jour. Sci.*, vol. , 1931, p. 1). The disease is caused by a filterable virus, and is transmitted by mosquitoes of at least two species in the Philippines, *Aedes egypti* and *A. albopictus*. It is shown that 5-10 infected mosquitoes convey the disease just as well as 150. The mosquitoes to become infected must bite the patient during the first two days of illness, but they do not transmit until twelve or more days later. It is probable that one attack of the disease confers a lasting immunity. Attempts to prepare prophylactic vaccines were unsuccessful. Attempts to transmit the disease to a number of animals failed, but evidence was obtained that two Philippine monkeys may act as reservoirs of the virus, and may be factors in the spread of dengue. A prolonged study of the blood during the course of the disease was made. An outstanding feature is a remarkable diminution in the white corpuscles at the height of the fever to one half the normal or even less.

A Bird Census in California.—Slowly increasing numbers of bird counts emphasise the variable size of the populations of areas of different character: there may be an average of less than a pair of birds to the acre in some places, and in others so many as fifty four pairs—both these record areas happen to be in the United States of America. A new region in California—the Lassen Peak Region—has been intensively studied by Joseph Grinnell, Joseph Dixon, and Jean M. Linsdale, and among the many interesting observations in their 500 page monograph appears a census of the birds (*Univ. California Publ. Zool.* vol. 35, 1930). The count covered an area of 6½ acres, searched daily at all hours of the day for 16 days in June, during the breeding season. Twenty four breeding pairs were established there, not quite four to the acre. Neither casual nor regular visitors to the checked area from other areas were included. The authors consider that the average population of the whole Lassen Region is over represented in the selected area, and from 'time' censuses and memory impressions they would place the general average at not more than one breeding pair to the acre. The results of the systematic study of the birds themselves suggest that where individuals of a particular species are sparsely distributed and the habitat greatly interrupted, the chances for developing and perpetuating local population strains are better than in an area of contrary nature. The mammals and reptiles of the Lassen Region, as well as the birds, give many apparently good cases illustrating this point.

True's Beaked Whale in the Hebrides.—An example of this very rare whale was stranded on the Outer Hebrides in January, and has been described by A. C. Stephen (*Scottish Naturalist*, 1931, p. 37). The length of the whale was 17 ft. 6 in., and the head, which is now in the Royal Scottish Museum, possesses the single pair of teeth, set at the extreme end of the lower jaw, which is a leading character of the species. Only twice before has this whale been found in British waters, on both occasions on the west of Ireland, and two further records, from the east coast of the United States of America, complete the known appearances of one of the most elusive of whales.

Spiders of Porto Rico.—The three parts of the work of this title recently issued (*Trans. Connect. Acad. Arts Sci.*, 30, 1-158, 159-335, 1929; 31, 1-191, 1930) represent the result of Prof. A. Petrunkevitch's stay as visiting professor to the University of Porto Rico during 1925-26. The spiders of the island are increased from 74 to 174 species in 100 genera; one genus and 72 species are new, and all are very fully described, with the help of 562 detailed diagrams. A

new method of describing the appearance of a spider's leg is introduced as being more accurate than words like 'stout' or 'slender'. This consists in expressing the breadth of the patella as a percentage of the united length of tibia and patella, and is known as the 'tibial index' Thus, for a pholcid the index is 2, for a theraphosid it is 13 A promised discussion of the Porto Rican fauna as compared with that of the other islands and of the clues as to its origin and evolution is eagerly anticipated

Echinoderm Oogenesis--L A Harvey (*Proc Roy Soc*, vol 107, 1930) discusses the cytology of oogenesis in *Antedon* and *Asterias* The chief difference noted is that in the oocyte of the former genus, a yolk nucleus is present, but not in the oocyte of *Asterias* Yolk appears in both under the influence of the Golgi apparatus, which consists of scale like dictyosomes visible in the living egg in *Antedon* but not in *Asterias* The mitochondria are early scattered in the cytoplasm and are present in large numbers It is suggested that they are concerned in the synthesis of yolk from raw materials in the cytoplasm Fat arises as minute droplets scattered among the yolk spherules, neither Golgi apparatus nor mitochondria are concerned in their appearance in the cell

Observations on Tetrarhynchids—Prof Th Pintner (*Sitz Akad Wiss Wien, Mat naturwiss Klasse* 139 Bd, 7 Hft, 1930) gives an account of the anatomy and systematics of some little known tetrarhynchid cestodes, with keys to the genera and species, and adds observations on the movements of the young encysted forms In the fresh liver of the teleostean fishes *Lepidopus* and *Brama*, the young worm lies motionless in the cyst, but as soon as the liver begins to decompose, movements in the head region begin Apparently only chemical or temperature stimuli will provoke these movements, for rough handling with a preparation needle produces no contraction The author suggests that a stimulus would be provided in the alimentary tract of the final host (an elasmo branch) when the liver is in process of digestion and would cause the larva to strive to free itself from the cyst The paper is illustrated by 73 figures

Researches on Diatoms—Miss S M Marshall and A P Orr continue their valuable researches on diatoms in their latest paper "A Study of the Spring Diatom Increase in Loch Striven" (*Journal of the Marine Biological Association of the United Kingdom*, 16, 3, 1930) Experiments with diatom cultures and sea water samples were carried on at the same time as the general studies During the three years 1926, 1927, and 1928, this increase was almost wholly due to *Skeletonema costatum*, which is able to grow within wide temperature limits There were very few other diatoms, and animals were scarce The pH value and oxygen content rose and the phosphate fell with the increase in numbers of diatoms It was found that temperature is not the direct cause of the beginning of the increase, but the density of the water which is influenced by the temperature is important, because it determines the amount of vertical mixing The vertical currents, besides bringing up the nutrient salts, carry the diatoms from the surface layers, where there is much light, to the deeper waters, where in winter and early spring there is not enough light for photosynthesis to balance respiration With the lengthening of the days and better weather conditions the depth at which photosynthesis may take place increases Regarding light intensity, it is shown that in Loch Striven the date of the spring diatom increase is apparently decided chiefly by the total light, which depends both on length of day and intensity

Crossing-over in Tetraploid *Primula sinensis*—An interesting paper by Miss D de Winton and Prof J B S Haldane (*Jour Genet*, vol 24, No 1) makes a comparison of the linkage relations in the diploid and the autotetraploid *Primula sinensis* Three factors are considered—*S*, which converts pin to thrum, *B*, which converts red flower to magenta, and *G*, which produces green stigma and ovary, inhibiting red Only *S* is fully dominant when present in one dose in the tetraploid Six of the seven possible types of linkage between these three factors in the tetraploid have been studied The intensity of linkage is about the same as in the diploid, but, unlike the diploid, there is no significant difference in the linkage on the male and female side The results agree well with theory, notwithstanding that Darlington (in the same number) has found numerous meiotic irregularities in the $4n$ form No evidence was obtained of crossing-over between more than two chromosomes of a set at one time, nor of two chromosomes going to the same pole after crossing over The results to be expected in the offspring of the different types of tetraploid zygote when selfed, with or without crossing over, are given in a useful table

'Collapse' in Australian Timber—C Sibley Elliot, assistant seasoning officer of the Australian Division of Forest Products, has an interesting paper in the *Journal* of the Council for Scientific and Industrial Research, vol 3, No 4, upon the occurrence of 'collapse' during drying of Australian timbers This is entirely different from the normal shrinkage and swelling of timber with changing water content Shrinkage is associated with an approach of the fibres towards one another as the timber dries, and cannot be prevented 'Collapse', on the contrary, involves the actual breaking down of many of the microscopic tubular elements in the wood, and it is frequently accompanied by considerable distortion in consequence 'Collapse' occurs in several of the Australian eucalypts to a considerable extent, in Australian grown timber it occurs mainly in the young outer wood or in wood from the upper part of the tree It may occur when the water content of the wood is still relatively high (more than 80 per cent), and has been attributed by H D Tiemann, of the Forest Products Laboratory, Madison, U S A, to the stresses set up within the wood by the continuous films of water in drying wood when air is unable to enter Whilst shrinkage of wood is inevitable as moisture content changes, the collapse can be corrected and permanently removed by the prolonged action of steam after the timber has been previously dried to a moisture content of 10 12 per cent This process, under the name of 'reconditioning timber', has been successfully adopted under commercial conditions in many large scale plants in Australia

Palæozoic Diatoms—An illustrated account of diatoms found in deposits of Carboniferous and Permian age is given by D Vito Zanon (*Mem Accad. Scienze, I Nuovi Lincei*, ser 2, vol 14, 1930, p 89) Some sixty species are recognised, most of which are identified with living forms

The Atlas Mountains—In the *Scientific Monthly* for February, Prof H C Lawson discusses the origin of the Atlas mountains of Morocco They have the characteristics of a youthful range, with narrow valleys, sharp ridges, and peaks The torrential streams flow in trenches far above the base level of erosion Features such as these cannot have survived from the time of the Alpine uplift, and Prof Lawson argues that the Atlas have undergone a rejuvenation His

reading of the evidence, which he details in full, is that at the end of the Eocene the Alpine uplift gave rise to what he calls the Alpine Atlas, on the site of the geosyncline which occupied part of the area of the submerged peneplain that succeeded the Hercynian mountains. By the end of the Tertiary period the Alpine Atlas had been reduced to a past mature hill range and the surrounding country to a peneplain. Then came the rejuvenation which led to the present Atlas. This was due to two movements: a broad arching which uplifted the peneplain to about 1200 metres, and a sharp orogenic upthrust between marginal faults. The degradation of the upthrust mass and consequent loss of load induced further rise by isostatic adjustment. The depressions flanking the range are explained as due to sinking of material in compensation for loss of load on the range.

The Atlantic Earthquake of 1929.—Two interesting papers on the earthquake of Nov. 18, 1929, by D. S. McIntosh and Dr. J. H. L. Johnstone appear in the *Transactions* of the Nova Scotian Institute of Science (vol. 17, pp. 213-222, 223-237, 1930). See also the letter by Prof. J. W. Gregory in NATURE, vol. 124, pp. 945-946, 1929). The cable breaks all occurred from lat. 39° 29′ to 45° 6′ N. and long. 52° 10′ to 57° 56′ W., that is, within an area of about 60,000 sq. miles, in a line with the old submerged portion of the St. Lawrence river. The depths at which the cables were broken range from 44 to 2934 fathoms, and the officers in charge of the repair work found no difference from the charted depths greater than those that might be due to errors in sounding. In many cases, the broken cable ends were found buried in mud or gravel. The ends appear as though the cable had been cut by a dull pair of heavy scissors, except at one spot (in lat. 43° 27′ N., long. 56° 13′ W.) where "the cable was found broken up in short lengths and the core twisted round the sheath. The wires of the sheath were bent back on themselves two or three times, wound around the core, and the latter twisted about the heavy galvanised steel sheath." From seismographic evidence, the epicentre is estimated by Messrs. Hodgson and Doxsee to lie in lat. 44° 5′ N., long. 55° 15′ W., which is nearly that obtained from the times of arrival of the sea waves at Halifax and the Newfoundland coast.

Variations of the Solar Constant and Terrestrial Weather.—Dr. C. G. Abbot, in a paper entitled "Weather dominated by Solar Changes" (*Smithsonian Miscellaneous Collections*, vol. 85, No. 1) continues his studies of variations of the solar constant and their influence on terrestrial weather. He finds that periods of increasing or decreasing solar radiation are followed by changes of pressure and temperature at Washington. These changes are irregular and differ considerably in different months, but those following increasing radiation are, on the whole, opposite to those following decreasing radiation, suggesting that though difficult to understand, they are probably real. An additional test is obtained by investigating the solar constant for periodicities; by a graphical method lengths of 8, 11, 25, 45, and 68 months are found, the combination of which reproduces the original curve with reasonable accuracy. The monthly mean temperatures at Washington for the period 1918–30, corrected for annual variation, are then analysed for the same periodicities and the results, with the addition of a terrestrial period of 18 months, are combined to form a curve not unlike the original. It should be remarked, however, that Dr. Abbot does not point out that the phases of the periodicities of temperature at Washington have no definite relation to the phases of the corresponding solar cycles. Moreover, if the 18-month periodicity is omitted, the calculated temperatures have a correlation of only 0.36 with the observed figures, so that they cannot be said to be "dominated" by solar changes, and the relationship will have little value for forecasting.

Lubrication and Viscous Flow.—Several investigators of lubricating oils have found that, when such oils are allowed to flow for some time through capillary tubes of internal diameter of 0.3 mm., the tubes become clogged in a few hours. This clogging has generally been explained as due to the orientation and adsorption of the polar constituents of the oil by the walls of the tube, and in the first Report of the Lubrication Research Committee, Sir William Hardy expressed the opinion that none of the liquid between two solid surfaces is free unless it is at least 5×10^{-4} cm. from each surface. The January issue of the *Journal of Research* of the U.S. Bureau of Standards contains a paper by Dr. R. Bulkley giving an account of his measurements of the flow of oils through capillary tubes, which have been carried out with the support of the Research Committee on Lubrication of the *American Society of Mechanical Engineers* to test whether this adsorption by the walls takes place. He finds that when the oils are filtered through porcelain before entering the capillary tube, they show no signs of clogging even in tubes of 11×10^{-4} cm. diameter. He considers that the evidence points more in the direction of slipping of the oil at the wall, or, if there is any increase of the viscosity of the oil near the wall, that increase does not extend more than 0.02 or 0.03×10^{-4} cm. from the wall.

Free Radicals.—Conant, Small, and Taylor in 1925 showed that halochromic (coloured) salts of triphenylcarbinol and related substances are reduced by powerful reducing agents in appropriate solutions with the formation of the free radical (for example, triphenylmethyl). A similar result would be expected in regard to the cations of the triphenylmethane dyes, except that the resulting free radical would probably be even less stable in acid solution than triphenylmethyl. In the February *Journal of the American Chemical Society*, Conant and Bigelow show that these expectations are confirmed by experiment. The following general reactions are assumed, in which R^+ is the dye cation and M^{++} the titanous, vanadous, or chromous ion used in reduction:

(1) $R^+ + M^{++} \rightleftharpoons R$ (free radical) $+ M^{+++}$,
(2) $2R \rightleftharpoons R-R$ ('ethane'),
(3) $2R + H^+ \longrightarrow RH$ ('methane') $+ R^+$,
(4) $2R \longrightarrow R_2$ (Chichibabin compound).

Reactions (1) and (2) are reversible and rapid; (3) and (4) are irreversible. The products of reactions (2), (3), and (4) were isolated in the case of malachite green and *p*-dimethylamino triphenylcarbinol. In order to isolate the associated free radical ('ethane'), advantage was taken of its relative insolubility in aqueous solutions of *p*H 3. The solutions absorb oxygen very rapidly, as much as 89 per cent of the amount required for peroxide formation being taken up by the crude dried material. The nomenclature used in (4) is based on the analogous formation of *p*-benzhydryl tetraphenylmethane from triphenylmethyl, first observed by Chichibabin, although the structures of the dimers obtained, isomeric with the 'ethanes', have not been established. Their empirical formulæ show them to be dimolecular reduction products of the cations. The action of vanadous or chromous chloride on the keto chloride of Michler's ketone is similar to the reduction of salts of the diphenyl carbinols. The electrochemistry of the reactions is to be studied.

The Invention of the Sewing Machine

ON Mar 8, M Herriott, the former premier of France, unveiled a monument at Lyons to Barthélemy Thimonnier, the inventor of the sewing machine Thimonnier applied for his first patent in collaboration with Auguste Ferrand of the School of Mines, St Étienne, on April 12, 1830, and the erection of the monument was the outcome of the celebration last year of the centenary of that event The commemoration which took place in Paris in May last included meetings in the Conservatoire national des Arts et Métiers, the Sorbonne, and elsewhere, a record of which is contained in the February *Bulletin de la Société d'Encouragement pour l'Industrie nationale*, which also contains a biographical sketch of Thimonnier by M Am Matagrin, of Lyons

Born at l'Arbresle, in the department of the Rhône, on Aug 19, 1793 Thimonnier attended school in Lyons and after an apprenticeship set up as a journeyman tailor at Amplepuis where he first conceived the idea of sewing by machinery Removing in 1825 to St Étienne, he lived in the rue des Forges, where he made a sewing machine and, with the assistance of Ferrand and others, not only secured a patent, but also in the summer of 1830 formed a company in Paris for the construction of machines By 1831, no fewer than eighty machines had been made, but a mob destroyed them all and for a time nothing more was done Thimonnier, however, continued all his life to devote much time to his invention, taking out other patents, and with Magnin forming another company but without reaping any adequate rewards He died a poor man, on Aug 5, 1857 The sewing machine by then had claimed the attention of many other inventors, but at the Paris Exhibition of 1855, Prof Willis, of Cambridge, reporting on the machines exhibited, said that Thimonnier's machine had served as a type for all modern sewing machines

Thimonnier's sewing machine was a chain stitch or single thread machine, in which the needle, having a notch near the point, left a loop beneath the material, through which the next stitch passed, but the machines developed by subsequent inventors were lock stitch machines, in which one thread is fed by the needle, which has an eye, and another thread is fed by a shuttle Thousands of patents have been taken out in connexion with such machines, but it was the work first of Elias Howe and then of Isaac Merritt Singer in the United States which brought the sewing machine into general use and provided the people of every nation with a simple, reliable machine at a reasonable price

There was a great deal of litigation between the early inventors, and the example of a Thimonnier machine in the Science Museum was one used during the trials in the United States If to Thimonnier the invention brought nothing but disappointment and anxiety, others were more fortunate, and Howe and Singer both amassed great wealth Though he died, as he lived, a simple working man Thimonnier to-day is remembered as a benefactor of his country, and the tablet marking the site of his house in St Étienne and the monument at Lyons will for a long time recall his gallant struggle against adverse conditions

The Climate of Sweden.*

SWEDEN lies in the region of prevailing south westerly winds that blow along the margin of the nearly permanent area of low barometric pressure centred near Iceland It appears from certain wind roses given on pages 52 and 53 of Axel Wallén's work, that it is only in the south—in Götaland—that there is a general predominance of south westerly winds in the surface layers of the atmosphere approaching that which is to be found in the British Isles Elsewhere, effects due to the distribution of land and water, and to the contours of the land, modify the general drift from the dominant quarter Thus, along the eastern coast, both in January and July, the wind tends to follow the trend of the coast line and therefore blows most frequently from southerly or northerly directions

The mountains that cover so large a part of Scandinavia greatly alter the effects of the moist Atlantic winds on the Swedish climate In the absence of such mountains, the climate would probably more nearly resemble that of Denmark there would not be the great contrasts that exist between the very wet western uplands and the dry eastern coastal region The heavy precipitation in the west leaves so much less moisture for cloud formation when the winds of the troposphere follow their usual course towards Finland and Russia, this is one of the factors that makes possible the wonderfully sunny summer climate of the eastern lowlands and of the islands off the east coast Students of British weather are familiar with this drying process, which acts powerfully in eastern Scotland and north east England during spells of westerly wind These general facts come to light in the course of a careful reading of Axel Wallén's work, but there is perhaps a tendency for a rather too rigid separation of the climatic factors This tendency makes it harder for the reader to get a grip of the broad facts of Swedish climatology, and to remember them, than would otherwise have been the case, the absence of an index and table of contents increases the reader's difficulties

On the whole, the manner in which the different sections are handled is orthodox More than usual attention is given to hydrology and matters of practical importance for the economic use of the abundant potential energy of the heavy rain and snow of the mountainous regions The snowfall is of use not only as a supply of water when it melts, but also, when lying, for the transport of felled timber by sledge to the commercial waterways The seasonal and annual variations of the total rainfall have their usual importance, in so far as they affect the flow of water in the rivers Sweden's extensive lakes, which occupy more than 8 per cent of the whole country, act as reservoirs capable of storing the surplus of an extra wet season It is not inappropriate in the case of a country so dependent economically upon the potential energy of rainfall to find that these various matters occupy 30 per cent of the space devoted to a discussion of climate There is a very instructive map (p 61) to which the reader's attention may be directed This shows the distribution throughout Sweden of water power, in kilowatts per square kilometre, for average conditions of waterflow

Readers of this work who are not familiar with the physical and other features of Sweden will appreciate the very clear maps among the first few pages These show the major and minor political divisions, the contours, the distribution of the different types of forest, facts relating to the late glacial epoch, and

* The Climate of Sweden By Axel Wallén Statens Meteorologisk Hydrografiska Anstalt Nr 270 B 65 (Stockholm, 1930) 2 00 kr

details of the principal river basins Another excellent point is the inclusion of a short discussion on inward and outward radiation This subject ought not to be neglected in the discussion of any climate and least of all in the case of one referring to a country placed in such high latitudes as to show very great seasonal contrasts In the extreme north of Sweden (lat 69°) the sun is never less than 2° below the horizon in the middle of the winter Even in the south (lat 56°) the solar elevation at that season does not exceed $10\frac{1}{2}°$ In the middle of the summer, on the other hand, a large part of Sweden enjoys perpetual daylight In the early summer, the average amount of cloud in the eastern lowlands falls below anything known in Great Britain and, in the islands off the east coast, reaches the low figure of 40 per cent in June When the long day is considered in relation to these facts no surprise will be caused by the statement (p 12) that the mean duration of sunshine at Jokkmokk (lat 66° 36′) in June exceeds that of Madrid or Rome in the same month In sympathy with the large annual variation of solar radiation, temperature shows great seasonal contrasts At Karesuands (lat 68° 27′) the mean temperature for July is about 28° C (50° F) higher than that for January

Figs 6 and 7 are among the most interesting in the book The former gives graphs of the radiation received at the outer limit of the atmosphere in each month in latitudes 55°, 60 65°, and 70°, similar graphs showing how much of this reaches the earth's surface when the sky is free from cloud, a graph of the radiation actually received at Stockholm, taking into consideration the amount of cloud, is also shown In Fig 7 this graph of inward radiation at the ground for Stockholm is compared with that of outward radiation at the same place The outward radiation has of course, much the smaller annual variation The comparison shows that from the beginning of October to the end of March the outward exceeds the inward radiation, and that the reverse is true during the rest of the year On the whole year it would appear that there is a gain The reader may be referred to recent papers by Dr G C Simpson Director of the Meteorological Office of Great Britain, for a more general discussion of this subject, which is by no means free from pitfalls

E V NEWNHAM

Afforestation Programmes of the New Zealand Forest Department

IN a recent number of NATURE (Feb 14, p 255) attention was directed to the organisation known as the New Zealand Timber Growers' Association, of New Zealand This body consists of a series of independent private companies engaged in afforestation work as a purely commercial proposition, with funds subscribed by the public on ordinary share issue terms These companies have no connexion with the official New Zealand Forest Department but it is already apparent that they will eventually own by far the largest area of artificially formed plantations in the islands Contrasted with the operations of these companies, already discussed in the note referred to, the Annual Report of the Director of the N Z State Forest presents the Government forestry position which is equally satisfactory On the subject of afforestation work the Report states "New Zealand possesses the largest area of State owned and State planted forests in the Empire The State owned indigenous forests as at March 31st, 1930, consisted of over 7 million acres The State Softwood Plantations, in round figures, at the same date, covered 253,600 acres The total area planted during the 12 months prior to the date mentioned was 56,630 acres For the current year a further 54,629 acres was programmed for, which would bring the total of New Zealand s State Softwood Plantations at this present date to a figure approximating 308,000 acres In the year ended March 31st, 1929, the State planted 60,635 acres altogether"

A contrast is then made with similar work in Great Britain The Forestry Commission in England, it is pointed out, planted to the end of 1929, 140,000 acres of softwoods, "while the planting programme is 23,000 acres per annum, so that New Zealand is well ahead of the Mother Country, and furthermore would be justified at the present time in claiming world leadership in annual softwood plantings under the State" Full credit may be given to the New Zealand authorities for the efficient manner in which they are dealing with this problem, but any attempt at rivalry in the rate of afforestation or in programmes with that sole end in view between the Dominion and Great Britain is most strongly to be deprecated Many things must govern annual planting programmes, and the delicate and important operations of thinning, once the young woods have reached the size for these operations, annually increase in amount and demand the closest attention Too often in the past have annual afforestation programmes been pressed on, to the neglect of the necessary thinning work in the young created woods, for which either the funds or the necessary labour were deficient or absent

The commercial planting companies have planted a total area of about 220 000 acres, the species being *Pinus insignis*, redwoods, *Pinus ponderosa*, and poplar Thus State plantings plus the planting of these afforestation companies now total approximately 500 000 acres, last year s total plantings being somewhere in the region of 100 000 acres

Since the commercial planting companies are wholeheartedly devoting themselves to new afforestation work it will be hoped that the Government Department is not losing sight of the important indigenous forests There may be quite valid reasons for embarking upon a large programme of plantations of exotics in a country—in parts of our Empire we know that such valid reasons exist—but all experienced foresters hold strongly to the belief that in the long run few exotic plantations can compete in value with the indigenous forest of a country

It is a well established fact that the planting of large blocks of exotics often as pure woods, leads to the danger of attacks of pests whether insect or fungus This factor has not been overlooked in New Zealand Research work in forest biology has been placed on a good basis by the linking up of the research forces of the State Forest Service the Department of Scientific and Industrial Research, and the New Zealand Timber Growers' Association, under the direction of Dr David Miller, with whom is associated Dr Marsden A number of research stations under the ægis of the State Forest Service have been established throughout the Dominion, the forestry schools of the University of New Zealand making contributions to the scientific side of afforestation Amongst studies on the commercial side of forestry, investigations into the strength of structural timbers are being carried out, and an extensive economic pulpwood survey is in progress with the object of establishing pulp and paper mills in promising localities

It is of interest to note that Australia continues to absorb practically the whole of the timber exports of New Zealand, but, the Report says, "enquiries from the United Kingdom continue to increase"

University and Educational Intelligence

London Applications for grants from the Dixon Fund, for assistance in scientific investigations, must be received before May 15 by the Academic Registrar, University of London, South Kensington, S W 7 Those for grants from the Thomas Smythe Hughes Fund, for assistance in medical research, must be received by the Academic Registrar not later than May 15

Oxford The recommendations of the committee appointed to consider and report on the provision of library facilities in Oxford have been embodied in a decree to be promulgated in Congregation on May 7 The recommendations include, as already noticed in Nature of Mar 28, p 493, the enlargement of the Radcliffe Scientific Library by the addition of a new wing

St Andrews —The Senatus Academicus will confer the honorary degree of LL D on the following, among others, on June 26 Sir James Hopwood Jeans, Dr G M Robertson, professor of psychiatry in the University of Edinburgh, Rev Alfred Young, formerly fellow of Clare College, Cambridge, rector of the parish of Birdbrook, Halstead, Essex, distinguished for his mathematical work

Under the will of the late Mr John McMaster, of Harbledown, near Canterbury, who died on Feb 10, the Ayrshire Education Authority will receive £300 a year for the establishment and maintenance of bursaries or scholarships to be known as "John McMaster Bursaries", tenable at the Universities of Edinburgh or Glasgow, and open to boys educated at Girvan Secondary School whose parents are in necessitous circumstances, and the Governors of Simon Langton Boys' School, Canterbury, £350 a year for the establishment and maintenance of scholarships to be known as "John McMaster Scholarships", tenable at the Universities of Oxford, Cambridge, Edinburgh, or London, to be awarded to boys of that school

The Educational Travel Association is arranging a summer holiday course in the methods of regional survey and in open air geography, in Norway The fiords, the subarctic tableland, and the eastern valleys round Oslo will be visited The party will sail from Newcastle on Aug 8 Particulars of the itinerary may be obtained by sending a 2d stamp to the honorary secretary, E T A, "Noddfa", Wistaston, Crewe (or, c/o Cheshire Training College, Crewe), who will supply an illustrated booklet and map, and a programme of excursions to glaciers and various land forms, as well as to the Norwegian open air museum, Viking ships, and Amundsen's unique collection of Eskimo tools, clothing, and kayaks Instruction in field work in the open air sciences will be given to members of the party desiring it

The League of Nations Union, in co operation with the American School Citizenship League, has again arranged a prize essay competition open to both British and American schools Prizes of 75 dollars, 50 dollars, and 25 dollars, known as the Seabury Prizes, are offered for the best essays in each of the following sections (1) Open to all pupils in public and secondary schools in the British Isles, on "What Subjects in the School Curriculum are Best Adapted to Show the Interdependence of Peoples?", and (2) open to all students in teachers' training colleges and university training departments, on "The Influence of Intellectual Co operation in the Promotion of World Friendship" Essays, which must not exceed 3000 words and must be written on one side only of paper with a margin of at least one inch, must reach the League of Nations Union, 15 Grosvenor Crescent, S W 1, not later than July 1 and should bear the writer's name, age, school, and home address

A list of international fellowships for research, compiled by the International Federation of University Women and published in pamphlet form, gives particulars of many hundreds of stipends available for advanced study and research in countries other than the stipend-holder's own The first and largest section relates to fellowships available only to nationals of one country Among other interesting items in this section are 42 American German exchange scholarships and about 170 Hungarian scholarships tenable in Vienna (40 to 56), Rome (40 to 46), Berlin (35) Great Britain (14), and elsewhere Great Britain's place in this section is a large one and so is Sweden's Section II contains fellowships open to students from more than one country or irrespective of nationality These are almost exclusively provided from British and American sources Appended is a list of nineteen *prizes open for international competition* Copies of the pamphlet can be obtained, price 1*s* 3*d* post free, from the British Federation of University Women, Crosby Hall, Cheyne Walk, London, S W 3

Birthdays and Research Centres

April 11, 1863 — Mr Henry Balfour, F R S, curator of the Pitt Rivers Museum, Oxford

I am at present investigating the stone implements of the Tasmanians, their technique and the culture status which they suggest

The scientific classification of primitive musical instruments and the determination of the geographical dispersal of related and analogous types would be a useful undertaking Primary classification must be based upon the exact method or mechanism whereby the sound is initiated, the means whereby the notes *may be varied being of secondary importance* In the new edition (fifth) of "Notes and Queries on Anthropology", pp 295 308, I have suggested a scheme of primary grouping, as an aid to descriptions and diagnosis of types of instruments Accurate description of the various means adopted for the production of the vibrations causing sound are required, in order to arrive at a satisfactory phylogenetic classification of musical instruments, and to enable the distribution of particular types to be mapped out

April 23, 1858 —Prof Max Planck, For Mem R S, professor of mathematical physics in the University of Berlin

Die theoretische Physik ist durch die Quantentheorie etwas in Unordnung geraten Sicher ist, dass von den bisher allgemein angenommenen Grundsätzen mindestens einer geopfert werden muss, um die übrigen aufrecht erhalten zu können Dies vollkommen klarzustellen ist eine der wichtigsten Aufgaben der nächsten Forschung Soweit ich sehe, gehört zu den Sätzen, welche unter allen Umständen beizubehalten sind, die Voraussetzung einer volkommenen Gesetzmässigkeit in allen physikalischen Vorgängen; dagegen zu denjenigen, welche fallen gelassen werden müssen, die Voraussetzung, dass der gesetzliche Ablauf eines Vorgangs dargestellt werden kann mittelst einer Zerlegung desselben in seine räumlichen und zeitlichen Elemente Es ist also der Begriff der Ganzheit, der wie auf dem Gebiet der Biologie so auch auf dem der Physik eingeführt werden muss, um die Gesetzlichkeit der Natur verstehen und formulieren zu können.

Societies and Academies.

LONDON

Geological Society, Mar 18.—O H Schindewolf, On the septal development and the genotype of the coral genus *Petraia* Munster The author, by showing that the genotype of *Petraia* is a synonym of *Petraia radiata* Munster, restricts the name to the Upper Silurian species The Devonian species belong to Počta's genus *Alleynia* *Petraia*, which is well characterised by its conical shape, deep calice, external ornamentation, arrangement of the septa, and, in normal specimens, by the absence of transverse tissue, has not been found outside Bavaria W B R King A fossiliferous limestone associated with Ingletonian Beds at Horton in Ribblesdale, Yorkshire The paper deals with an exposure of green felspathic grits with associated calcareous rocks in the railway cutting south of Horton in Ribblesdale station The problems of general stratigraphy are discussed There is much evidence of a general nature to suggest that although the limestone is undoubtedly of Ashgillian age, the grits with which it is associated must be considerably older Calcareous matter occurs in two forms in the cutting, first, as the infilling between the grit blocks of a breccia, and secondly, as a crystalline fossiliferous limestone apparently interbedded with the grits A detailed study of the limestone, however, shows that it is essentially of the same origin as the calcareous part of the breccia, since it contains angular fragments of grit and occasional flakes of roughly cleaved green mudstone of a type exactly like the Ingletonian of the neighbourhood The fossils show no signs of distortion by cleavage It is suggested that this is another case of a 'Neptunian dyke'

Linnean Society, Mar 19.—M Bernhauer and H Scott Abyssinian Staphylinidæ systematic report and introduction, with biogeographical and ecological remarks Dr Bernhauer enumerates 123 species, only 11 of which had been recorded from Abyssinia before, while 56 are new to science The affinities of the Staphylinidæ under review are mainly African, but there is a small proportion of Palæarctic species or related forms Among many kinds of environment, special attention was paid to dead stems of tree Euphorbias (*Euphorbia abyssinica*) and of tree Lobelias (*Lobelia Rhynchopetalum*), and species apparently peculiar to these habitats were found

Society of Public Analysts, April 1.—R C Frederick Carbon monoxide poisoning its detection and the determination of the percentage saturation in blood, by means of the Hartridge reversion spectroscope The instrument is capable of giving a quantitative determination of very small percentages of carbon dioxide in a minute quantity of blood The author has been unable to confirm Haldane's conclusions on nitrogen monoxide hæmoglobin, the reversion spectroscope showing that the nitrogen monoxide hæmoglobin spectrum is quite different from that of carbon monoxide hæmoglobin.—H M Mason and G Walsh Experiments on the hardness of fats A simple apparatus has been devised in which the weight required to drive a plunger into the solid cake of fat of standard thickness under standard conditions is measured The results of the hardness test have also been used to establish the identity of fats and to detect adulteration.—B S Evans A new process for the determination of small amounts of bromide in chloride Bromides are rapidly and completely oxidised by chromic acid in the presence of sulphuric acid, preferably of 8-9 N strength, whilst chlorides remain untouched The liberated bromine is conveyed by means of a current of air into an absorption flask containing standard arsenious oxide solution and some sodium bicarbonate, and the excess of arsenious acid is titrated with standard iodine For determining small percentages of bromides in chlorides, the bromine is first absorbed in a tube containing 0.5 per cent sodium hydroxide solution, and this solution is then treated with one or two drops of saturated sulphur dioxide solution, then with dilute sulphuric acid and chromic acid, and the determination completed as described.—S G Walton and R G O'Brien The use of bromine as a reagent in the determination of alkaloids The thalleioquin reaction for quinine has been made quantitative the excess of bromine being removed by aeration, and the coloration compared with that given by standard solutions An iodometric development of the method enables quinine to be determined in the presence of other alkaloids The bromine compounds of morphine and most of the other opium alkaloids liberate iodine from potassium iodide, and methods of determination are based on the reactions Codeine may be determined colorimetrically by measuring the depth of the red colour formed on oxidising its bromine compound with hydrogen peroxide Colorimetric methods have also been devised for the ipecacuanha alkaloids, based on the yellow coloration formed on aerating the bromine compounds

DUBLIN

Royal Irish Academy, Feb 23.—T J Nolan and M T Casey Further studies in the pigment of the berry of the elder (*Sambucus nigra*) From the berry of the elder, two anthocyan pigments have been isolated in crystalline form as chlorides One of these is identical with chrysanthemin, the pigment of the dark red garden chrysanthemum The second pigment, sambucicyanin, which crystallises in long prisms, is, according to analysis, a bi molecular compound of chrysanthemin with a pentose-glucoside of cyanidin The two pigments are similar in their colour reactions, but sambucicyanin is more soluble in hydrochloric acid and in alcohol than chrysanthemin No methyl pentose glucosides were isolated, and the authors are unable to confirm the observation of Karrer and Widmer that a rhamnoglucoside is present in the berry

Royal Dublin Society Mar 24.—W R G Atkins Observations on the photoelectric measurement of the radiation from mercury vapour lamps and from the sun, and on the effects of such radiation on the skin A vacuum sodium photoelectric cell, made of glass, and selective screens were used to study the radiation from a Hewettic Levick Ulviarc mercury vapour arc used for clinical work It is generally advisable to run the arc continuously between treatments, as the maximum illumination is not reached until 6 min after the lamp has been switched on A subsequent slow decline is attributed to gradual over heating, to counteract which the lamp should be switched off for a minute or two after 35-40 min, 5 min after switching on again the original maximum is recovered Irregular fluctuations in the light of the arc do not seem to be caused by cooling due to draughts, and are probably due to variations in the supply voltage The radiation from a lamp which had been in use 750 hours, and had been discarded as uneconomical of time for clinical work, was found to be 40 per cent for the blue, violet, and ultra violet, 36 per cent for the ultra violet, and 24 per cent for the anti rachitic ultra violet, as compared with a new lamp The new

lamp may produce slight erythema in 1 minute and definite erythema in 2 min at a distance of 60 cm Noon sunlight (93,000 metre candles on the potassium carbon arc scale) produces some effect in 10 min and definite erythema in 30 min Beck's ultra violet fluorescence spectroscope was useful for qualitative observations Approximate photoelectric determinations of the ultra violet light in daylight showed that in this respect, even at mid summer noon, the direct sunlight is not very much more potent than the diffuse light from the sky

PARIS

Academy of Sciences, Mar 2 — **H Deslandres** Simple relations of molecular spectra with the structure of the molecule — **Gabriel Bertrand** and **Mme Georgette Lévy** The amount of aluminium in plants, especially those utilised as food The proportions of aluminium found in a large number of edible roots, tubercles, seeds, and leaves are given — **Jean Effront** The fall in the rotatory power of solutions of glucides under the action of alkalis — Charles Jacob was elected a member of the Section of Mineralogy, in succession to the late P Termier **Pasquier** The equations $s = f(x, y, z, p, q)$ integrable by the Darboux method **J Schreier** and **St M Ulam** A property of the unit of Lebesgue — **A Lokchine** The rotating vibrations of a body limited by a surface of revolution — **Henri Poncin** The possible permanent movements of a heavy fluid — **B Hostinsky** The theory of diffusion — **A Sesmat** A new hypothesis on radiation and on the optics of bodies in motion — **Pierre Lejay** An arrangement allowing the amplification of weak photoelectric currents and its application to recording the light flux proceeding from the stars The apparatus described in an earlier communication, utilising ordinary amplifying valves as electrometers, has been improved by the addition of a new type of valve In combination with a photoelectric cell and a recording oscillograph, the apparatus can be used to record the passage of a star in meridian observations, or to measure intensities, as a recording photometer — **Clerget** Apparatus for observing the phenomena of injection in compressed air **Georges Fournier** and **Marcel Guillot** The absorption of the β rays by matter The same absorption coefficients were found for liquid and solid white phosphorus, but there appeared to be a slight difference between the absorption coefficients of the two allotropic forms of phosphorus — **F Bourion** and **E Rouyer** The cryoscopic study of paraldehyde in solutions of calcium and strontium chlorides — **J J Trillat** and **J Forestier** The structure of plastic sulphur Threads of plastic sulphur, pulled out immediately after formation, become less transparent, lose their elasticity, and give a much higher breaking load increasing from 70 gm to 9 or 10 kgm per sq mm The threads, which were amorphous before stretching, behave as crystalline fibres X rays increase the rate of crystallisation of plastic sulphur — **A Mailhe** and **Renaudie** The catalytic condensation of the amylenes Heated to 670°, in presence of silica gel, the amylenes give gases (unsaturated hydrocarbons, methane, hydrogen) and a mixture of liquid unsaturated and aromatic hydrocarbons Benzene, toluene, and xylene were definitely identified — **Charles Dufraisse** and **Raymond Horclois** The application of the antioxygen effect to the problem of fire extinguishing The negative catalysis of the ignition of carbon As with low temperature oxidations, ignition can be hindered by negative catalysts **A Grebel** The process of combustion of pulverised coal — **Conrad Kilian** The genesis of the Central Sahara Massif — **Henri Termier** The discordances in the palæozoic series of Central Morocco — **G Garde** The old course of the Allier and its affluents on the Gannat during the Upper Pliocene and Quaternary — **A Demay** The prolongation of the Cevenol tectonic complex in the Louvesc mountains — **Guilliermond** The conjugation of the ascospores in the yeasts and some obscure points in the development of these fungi — **Mlle Cassaigne** The origin of vacuoles In most cases, the vacuoles arise spontaneously in the cytoplasm, but they can also be produced by the drawing out and breaking up of preformed vacuoles, phenomena which appear to be determined by the movements of the cytoplasm — **Gustave Jaquenaud** The influence of the nature of the soil and of radiations on the degenerescence of the potato — **J Nageotte** The variations of the sign of double refraction in myelinic figures and connected formations — **H Simonnet** and **G Tanret** The calcifying action and the toxic action in the animal of large doses of irradiated ergosterol an attempt to separate those two actions It is established that the irradiation products of ergosterol contain two distinct factors, one toxic the other calcifying The calcification is much reduced when small doses of potassium iodide are administered along with the irradiated ergosterol

ROME

Royal National Academy of the Lincei Communications received during the vacation, 1930 — **G Castelnuovo** De Sitter's universe — **L Rolla** Experiments on the concentration and isolation of the element of atomic number 61 Fractionation of the rare earths obtained from monazite sand, and spectroscopic examination of the different fractions, has failed to produce evidence of the presence of the element of atomic number 61 — **G Barba** Absolute geodetics of surfaces — **B de Finetti** Characteristic functions of instantaneous laws — **Luisa Pelosi** Mean curvature of surfaces The new expression recently evolved by Calonghi for the mean curvature of a surface may be derived by a more rapid and simple calculation — **E Čech** Further considerations on Cauchy's theorem — **S Amante** Resolution, in the field of complex matrices, of any analytical equation with numerical coefficients — **L Fantappiè** Maxima and minima of real analytical functionals — **S Finikoff** The congruence R having two 'gauche' surfaces for the two folds of its focal surface — **E Gugino** The dynamic problem of any linked system reduced to the analogous problem relating to a free system — **A Signorini** The finite deformations of continuous systems An introduction, purely kinematic in character, is given to a summary of various studies on the finite deformations of continuous systems with reversible transformations, especially on those of elastic systems — **Angelina Cabras** Rigid motions in generalised spaces — **A Masotti** Rectilinear vortex in a channel with plane parallel sides — **A Fresa** Variations of the light of the variable RZ Cassiopeiæ Investigation of the light curve of this variable reveals the existence of a well defined secondary minimum in the neighbourhood of the maximum preceding the principal minimum, of a slight inflexion, possibly periodic, of the light curve on the descending branch, and of an increase of 0 86 second in the period of the variable — **Seb Timpanaro** Waves and corpuscles — **D Graffi** Considerations on the theory of the transmission of heat by forced convexion (2) From the theorem of unicity established in the previous note on this subject, a principle of superposition of effects is developed — **A Quilico** The oxidation of propenyl derivatives by means of diazo compounds The mechanism recently suggested by Angeli and Polverini for the oxidation of propenyl compounds by diazohydrates is discussed and evidence advanced in sup-

port of it —Clara Forti The excision of the vessels and nerves of the ovary total or partial excision and sexual functions (2) Experiments with rats show that the excision of ovarian vessels and nerves does not markedly disturb, even after several months, the sexual cycle Excision of the nervo-vascular fibre of the ovary and uterus does, however, cause serious and persistent alterations in the sexual functions

Official Publications Received.

BRITISH.

The Animal Year Book Issued by the University of London Animal Welfare Society Vol 1 (1931). Edited by Dr C M Knight and C W Hume Pp 173. (London University of London Press, Ltd) 2s net.

Survey of India. Professional Paper No. 26 Mount Everest and its Tibetan Names A Review of Sir Sven Hedin's Book, by Col Sir Sidney Burrard Pp ii+18. (Dehra Dun) 8 annas, 10d

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1930 (No 79) Pp 135+5 plates. (Marlborough) To members, 3s , to non members, 5s

Education (Scotland) Report for the Year 1930 by the Director on the Royal Scottish Museum, Edinburgh Pp 16 (Edinburgh)

Uganda Protectorate Summary of Progress of the Geological Survey of Uganda for the Years 1919 to 1929 Pp. ii+44+6 plates (Entebbe Government Printer) 4s

Transactions of the Institute of Marine Engineers Incorporated Session 1931 Vol 43, No 2, March Pp 57 112+xliv (London)

Memoirs of the Department of Agriculture in India Botanical Series Vol 17, No 5 Cotton Growing in India in relation to Climate By Trevor Trought and Mohammad Afzal Pp 117 186 (Calcutta Government of India Central Publication Branch) 12 annas 1s 3d

Department of Agriculture, Straits Settlements and Federated Malay States General Series, No 4 Reports of Agricultural Field Officers for the Year 1929 Pp vi+94 (Kuala Lumpur)

Memoirs of the Commonwealth Solar Observatory Memoir No 2 The Luminosities and Parallaxes of 350 Stars of Spectral Type B By W B Rimmer Pp 37 (Canberra H J Green)

The Glasgow Naturalist the Journal of the Natural History Society of Glasgow (including the Transactions and Proceedings of the Society, Third Series) Vol 9, 1919-1930 Pp vii+124 (Glasgow John Smith and Son, Ltd) 5s 6d

Tanganyika Territory Department of Tsetse Research Co-ordination Report No 4 1st April 1930 to 30th September 1930 Pp 12 (Dar es Salaam Government Printer) 1s

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1350 Reports and Memoranda published between 1st September 1929 and 31st December 1930 Pp 8 6d net No 1357 (Ae 488—T 2987) Variable Density Wind Tunnel Test Data on Models of the Hawker Hornbill Aeroplane and the AD 1 Aerofoil Section By W S. Diehl and R F Anderson Pp 9+11 plates. 1s net. No 1346 (Ae. 478—T 2992) The Application of the Method of Operators to the Calculation of the Disturbed Motion of an Aeroplane By L W Bryant and D H Williams Pp 18 9d net. (London H M Stationery Office)

Journal of the Chemical Society March Pp iv+445 674+x (London.)

Physical Map of the Union of South Africa and adjoining Territories Compiled by Eric H Banks In 4 sheets, 40 in × 30 in (Pretoria Government Printing Office)

Report of the R.101 Inquiry (Cmd 3825) Pp 129 (London H M Stationery Office) 2s 6d. net.

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1930 presented to the Annual Meeting, February 9th, 1931 Pp 46+5 (York)

FOREIGN

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 103 The Effects of Topping Egyptian Cotton Plants By Dr J Templeton Pp 9+2 plates (Cairo Government Press) 3 P T

Denkschriften der Schweizerischen Naturforschenden Gesellschaft Band 66, Abh 1 Die Spätbronzezeitliche Keramik der Schweiz und ihre Chronologie Von Emil Vogt Pp ii+80+9 Tafeln (Zürich Gebrüder Fretz A. G)

Publications of the Kapteyn Astronomical Laboratory at Groningen No 45 The Secular Parallax of the Stars of different Apparent Magnitude and Galactic Latitude By P J Van Rhijn and B J Bok Pp ii+24 (Groningen Hoitsema Bros)

Scientific Papers of the Institute of Physical and Chemical Research Nos 286 287 A Relation between Orthobaric Volumes and Temperature by Jurô Horiuti , Note on the Spark Spectra of Chlorine, by Kiyoshi Murakawa. Pp. 89 109 (Tôkyô Iwanami Shoten) 40 sen

Bergens Museum Årsberetning, 1929-1930. Pp 94. Årbok, 1930 Naturvidenskapelig rekke. Hefte 2 Pp. 170 (Bergen A S John Griegs Boktrykkeri)

Memoirs of the College of Science, Kyoto Imperial University Series A Vol. 14, No 1, January Pp 42. (Tokyo and Kyoto Maruzen Co , Ltd) 1 00 yen

Bulletin of the American Museum of Natural History Vol 59 Art. Fossil Turtles of Mongolia. By Charles W Gilmore Pp 213-257+1 plates. (New York City)

Report of the Aeronautical Research Institute Tôkyô Imperial University No 67 Air Flow through Exhaust Valve of Conical Seat By Keikiti Tanaka. Pp. 24. (Tôkyô Koseikai Publishing House) 0 19 yen

Proceedings of the Imperial Academy Vol 7, No 1, January Pp 28 (Tokyo.)

Republica Argentina Ministerio de Agricultura de la Nación Anales de la Dirección de Meteorologia Tomo 18 Conteniendo las observaciones practicadas en los años 1924, 1925, 1926 y 1927 Vol. 2 Datos meteorologicos Pp 52+96 mapas. (Buenos Aires.)

Ministerio da Agricultura, Industria e Commercio Observatorio Nacional do Rio de Janeiro Taboas das Marés para o anno de 1931 nos Portos do Rio de Janeiro, Belém, S. Luiz, Amarração Camocim, Fortaleza, Natal, Cabedello, Tambahú, Recife, Aracajú, Bahia, Ilhéos, Santos e Paranaguá. Pp 186 (Rio de Janeiro.)

Publikationer fra det Danske Meteorologiske Institut Aarbøger Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1930 Pp. 17+5 maps (København G E C Gad)

Conseil Permanent International pour l'Exploration de la Mer Journal du Conseil Rédigé par E S Russell Vol 6, No 1, Mars Pp. 153 4 50 kr Rapports et procès verbaux des réunions Vol. 71 Report of the Transition Area Committee concerning Plaice Investigations in the Kattegat and Skagerak Pp. 118 4 50 kr Faune ichthyologique de l'Atlantique nord Publiée sous la direction de Prof Joubin No 5 24 planches, avec texte 4 00 kr (Copenhague Andr Fred Høst et fils)

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Egyptian Government Central Narcotics Intelligence Bureau Annual Report for the Year 1930 Pp. xiii+109+19 plates (Cairo Government Press)

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Journal of the Faculty of Agriculture Hokkaido Imperial University Vol 30, Part 1 Studies on the Absorption of Ammonia and Nitrate by the Root of Zea Mays Seedlings in relation to the Concentration and the Actual Acidity of Culture Solution By Tsung Lê Loo Pp 118+1 plate (Tokyo Maruzen Co , Ltd)

State of Connecticut Geological and Natural History Survey Bulletin No 48 Additions to the Flora of Connecticut By Edgar Burton Harger Dr Charles Burr Graves, Dr Edwin Hubert Eames Charles Alfred Weatherby, Richard William Woodward, George Henry Bartlett (First Supplement to Bulletin No 14) Pp 94 (Hartford Conn) 75 cents

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science Special Bulletin No 205 Soil Fertilization for Sugar Beets. By James Tyson and M M McCool Pp 81 Special Bulletin No 206 Types of Farming in Michigan By E B Hill F T Riddell and F F Elliott Pp 83 Technical Bulletin No 107 The Lansing Food Survey By C A Scholl and W O Hedrick Pp 152 (East Lansing Mich)

Instituts scientifiques de Buitenzorg 's Lands Plantentuin Treubia recueil de travaux zoologiques hydrobiologiques et océanographiques. Vol 12 Livraison 3 4 Décembre 1930 Pp. 263-477 (Buitenzorg Archipel Drukkerij) 5 00 f

CATALOGUES.

Medical Books including Surgery Nursing Dentistry Pharmacy Anatomy, Ophthalmology Hygiene, Homœopathy, Sexology, Pathology etc Pp. 44 (London W and G Foyle Ltd)

Petrological Microscopes and Accessories Pp 24+20 (London James Swift and Son Ltd)

The Taylor Hobson Outlook Vol. 3 No 18 March Pp. 165 172 (Leicester and London Taylor Taylor and Hobson Ltd)

Books in various Branches of Science (No 466) Pp. 52 (Cambridge Bowes and Bowes)

Diary of Societies

FRIDAY, APRIL 17

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North Western District) (at Victoria Station, Manchester) at 9 30 A M

BRITISH INSTITUTE OF RADIOLOGY (at North Middlesex Hospital, Edmonton), at 11 A.M.—At 5 —Meeting of Medical Members

ELECTRICAL ASSOCIATION FOR WOMEN (at Park Lane Hotel) at 11 30 A.M —Annual General Meeting —At 3 — Report from Branches, etc

LONDON SOCIETY (at Royal Society of Arts), at 5 —Dr D McKenzie Noise—a Modern Plague of London

SOCIETY OF MEDICAL OFFICERS OF HEALTH (at 1 Upper Montague Street, W C), at 5 —Dr Ethel Cassie, Dr G C M M'Gonigle, and others Discussion on the Pre school Child

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5 —A J Maddock The Generation of Current Pulses of Rectangular Wave form —R A Fereday An Improved Method for the Comparison of Small Magnetic Susceptibilities —Dr E G Richardson Edge Tones

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (Annual General Meeting) (at Royal Society), at 5

ROYAL SANITARY INSTITUTE (at Guildhall, Poole), at 5 —E J Goodacre and others Discussion on Some Aspects of Municipal Sanitation — Alderman J C Julyan and others Discussion on Prospect and Retrospect.—Dr G Chesney and others Discussion on Diphtheria Immunisation at Work

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —C D Gibb Post War Land Turbine Development

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon Tyne), at 6.—J Foster King Corrosion of Oil Tankers

COKE OVEN MANAGERS ASSOCIATION (Midland Section) (at Sheffield University), at 6 30 —Prof R V Wheeler Rational Analysis of Coal

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7 – Annual Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7 —E W Hill and G F Shotter Current Transformer Summations

INSTITUTE OF FUEL (East Midlands Section) (at University College, Nottingham), at 7 —H L Pirie Theory and Practice of the Gasification of Coal in Producers

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College Newcastle upon Tyne) (Annual Meeting), at 7 30.—Demonstration of Modern Scientific Instruments and Apparatus of Special Interest

INSTITUTE OF METALS (Sheffield Section) (in Non Ferrous Section of Applied Science Department, University of Sheffield), at 7 30 —R Genders Extrusion

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —J E Gray The Transmission of Gas.– T G Martin The Building Requirements of Lifts

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section) at 8 30 — Dr J C Mottram Secondary Radiation in Bone —Dr J Halliwell Pyelography – Dr C A Robinson Backache in its Relation to Cervicitis, and its Treatment by Diathermy

INSTITUTE OF BREWING (Yorkshire and North Eastern Section) (at Queen s Hotel Leeds) —Annual Meeting

SATURDAY, APRIL 18

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Sowerby Bridge) at 2

MINING INSTITUTE OF SCOTLAND (at Royal Technical College Glasgow) at 3 —Annual General Meeting

MONDAY, APRIL 20

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 — Alderman R Tweedy Smith and others Discussion on Everyday Commercial Risks of and Liabilities to Engineers

BRITISH KINEMATOGRAPH SOCIETY (at Film House Wardour Street), at 7 45 —J Ree The Fidelytone Sound Recording System

ROYAL SOCIETY OF ARTS, at 8 —Dr N A V Piercy The Present Position in Aeronautics (Howard Lectures) (2).

ROYAL GEOGRAPHICAL SOCIETY at 8 30 —Major R. A Bagnold Journeys in the Libyan Desert 1929 and 1930

ROYAL SOCIETY OF MEDICINE at 9 15 —Dr C Wilson Some Aspects of Alpine Climbing

TUESDAY APRIL 21

ROYAL SOCIETY OF MEDICINE, at 5 30 – General Meeting

INSTITUTE OF FUEL (North Western Section) (at 17 Albert Square, Manchester) (Annual General Meeting), at 7 —C A Seyler Fuel Technology and the Classification of Coal

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7 30 —W G Mackenzie Some Aspects of Street Lighting in the United States

WEDNESDAY, APRIL 22

GEOLOGICAL SOCIETY OF LONDON at 5 30.—Dr H H Thomas and W Campbell Smith Xenoliths of Igneous Origin in the Trégastel Ploumanac h Granite Côtes-du Nord France —C I Gardiner and Prof S H Reynolds The Loch Doon Granite Area Galloway

SOCIETY OF CHEMICAL INDUSTRY (jointly with British Association of Chemists and Institute of Chemistry) (at Technical College, Derby), at 7 —Dr A Bramley Diffusion in Solids

ROYAL SOCIETY OF ARTS, at 8.—Prof Major Greenwood The Work of the London School of Hygiene and Tropical Medicine followed by a demonstration by Prof J G Thomson of a Malaria Film

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London) at 8 30 —Dr H V Dicks A Clinical Study of Obsession

THURSDAY, APRIL 23

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 — Discussion on Recent Work in the Additive Theory of Numbers, to be opened by Prof G H Hardy, followed by E Maitland Wright New Partition Problems —A. E Ingham The Method of Brun and the Theorem of Schnirelmann —Dr A E Western Computative Work Connected with Waring s Problem —Other speakers Prof L J Mordell, S. D Chowla, Dr T Estermann, and Prof J E Littlewood

COKE OVEN MANAGERS ASSOCIATION (Northern Section) (at Three Tuns Hotel Durham) —Discussion

FRIDAY, APRIL 24

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30 —Sir William Foster John Zoffany in India

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Westminster Hospital) at 4 30

INSTITUTE OF MARINE ENGINEERS, at 6 —Annual General Meeting

INSTITUTION OF MECHANICAL ENGINEERS, at 6 —Sixth Report of the Marine Oil Engine Trials Committee

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6.15 —J Dunbar The Design and Manufacture of Electrical Apparatus

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Waldorf Hotel Aldwych), at 6 45 —At 7 30 —Sir Richard Gregory, Bart. Science in Industry

BRITISH ASSOCIATION OF CHEMISTS (Scottish Section) (at Central Halls, Glasgow), at 7 30 —Annual General Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir Philip Hartog Joseph Priestley and his Place in the History of Science

SATURDAY, APRIL 25

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30

PUBLIC LECTURE.

TUESDAY, APRIL 21

GRESHAM COLLEGE at 6 —W H Wagstaff Geometry (Succeeding Lectures on April 22, 23 and 24)

DISCUSSION.

APRIL 17 AND 18

GENERAL DISCUSSION ON PHOTOCHEMICAL PROCESSES.

FARADAY SOCIETY (in Department of Chemistry Liverpool University)

Friday, April 17, at 10 A M —Molecular Spectra in Relation to Photochemical Change

Introductory Paper Prof R Mecke

Ultra violet Absorption Spectra of Acetylene and Formaldehyde Dr G Herzberg

The Absorption Spectra and the Optical Dissociation of the Hydrides of the Oxygen Group C F Goodeve and N O Stein

The Photochemical Properties of the Carbonyl Group F W Kirkbride and R G W Norrish

Friday, April 17, at 2 30 —Photochemical Kinetics in Gaseous Systems

Introductory Paper Prof M Bodenstein

The Reaction between H_2 and O_2 under the Influence of Photochemically produced H Atoms. The Relation of its Mechanism with that of the Explosive Gas Reaction at High Temperatures. Dr W Frankenburger

The Photochemical Union of Hydrogen and Chlorine at Low Pressures I B Bateman and H C Craggs.

The Photosensitised Decomposition of Nitrogen Trichloride by Chlorine, and the Induction Period of the Hydrogen Chlorine Reaction J G A. Griffiths and R G W Norrish

The Photosensitised Formation of Hydrogen Peroxide in the System Hydrogen Oxygen Chlorine R G W Norrish

The Photochemistry of Mixtures of Chlorine Oxygen and Carbon Monoxide Prof G K. Rollefson

The Mechanism of the Photo Oxidation of Gaseous Alkyl Halides J R Bates and R Spence

A Comparison of the Efficiency of Photochemical Reactions and Similar Reactions Produced by Gaseous Ions G R Gedye

Saturday April 18 at 10 A.M —Photochemical Change in Liquid and Solid Systems

Introductory Paper Prof A Berthoud

The Photochemical Temperature Coefficient D W G Style

The Acceleration of the Electrolytic Deposition of Hydrogen and Oxygen by Light of Short Wave Length Dr F P Bowden

The Photochemical Decomposition of Chlorine Dioxide in Carbon Tetrachloride Solution Y Nagai and C F Goodeve.

The Photochemical Oxidation of Potassium Oxalate by Iodine in Aqueous Solution. Prof A J Allmand and K W Young

A Comparative Study of the Photographic Process under Different Experimental Conditions. Prof J Eggert.

The Latent Photographic Image New Methods of Investigation and Results Prof F Weigert.

Sensitisations of the First and Second Type Prof F Weigert

Saturday April 18, at 2 30.—Photosynthesis

Introductory Paper Prof E C C Baly

The Application of the Einstein Law to Photochemical Processes in Living Cells Prof O Warburg

The Measurement of the Physiologically Active (Erytheme forming) Ultra Violet by means of the Photochemical Formation of Dyestuffs from the Leuco Compounds of Triphenyl Methane Dyes Edith Weyde and W Frankenburger

CELEBRATION.

APRIL 22, 23, AND 24

TEXTILE INSTITUTE (Coming-of Age Celebrations) (at Midland Hotel Manchester).

Wednesday April 22 at 7 30 —Reception

Thursday, April 23, at 10 30 A.M —Lectures

At 2.15 —Visit to Shirley Institute.

Friday, April 24, at 10 30 A M —Lectures.

At 2 15 —Visit to Manchester Ship Canal

At 8 —Public Lecture (in Houldsworth Hall).

SATURDAY, APRIL 25, 1931.

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No 3208, Vol 127]

The Loss of the Airship *R101*.*

THE Report of the *R101* Inquiry, to which reference was made in NATURE of April 11, represents the unanimous finding of Sir John Simon and his two assessors, Lieut-Col J T C Moore Brabazon and Prof C E Inglis It is a remarkable document, in that it contains probably all the available relevant knowledge of the various phases of airship work, culled from a variety of sources, and presented in the form of a logical and reasoned argument that bears the obvious imprint of Sir John Simon's unbiased legal mind The witnesses called before the court were, roughly, of three types, namely, those professionally concerned with the design and construction of the airship, who dealt with their own specialities, eyewitnesses of the disaster, mostly non-technical, whose evidence served to confirm or disprove certain theories, and other airship experts who came forward with suggestions of their own to assist the court These matters are dealt with in one part of the Report Another section is devoted to the question of assessing the responsibility for the existence of the general state of affairs that led to the undertaking of the flight to India at that time

The court, in justification of the conclusions of its Report, says

"In discussing the cause of the accident, one starts with a series of definitely ascertained facts It is then possible to exclude, by a process of reasoning which appears conclusive, certain suggested explanations which need to be examined before they can be rejected In the result, the analysis indicates, with some degree of confidence, the general nature of the true cause, though precise detail can never be attained, since no one who was in the control car has survived"

The final movements of the ship leading to the crash can be, it is suggested, divided into three phases First, the ship, while in a deliberate downward pointed attitude correcting an upward deviation, was caught by a down current, and descended through a steep angle for about half a minute, thus losing height to a dangerous extent It was probably brought to an approximately horizontal attitude by the use of the maximum possible up-elevator by the end of this dive Second, in spite of using all the devices provided, the commander found that he was unable to get her nose up and regain his lost height, the ship continuing horizontal flight probably for a few seconds Third, another

* Cmd 3825 (London H M Stationery Office) 2s 6d net.

dive at about fifteen degrees, during which she struck the ground In this last phase it was evident that those in charge had realised that a landing was inevitable and were seeking to minimise the crash Their efforts were so far successful that the actual mechanical damage was remarkably slight, and the estimated forward speed at the time of impact was no more than four to five miles per hour The fire broke out after the ship struck the ground, and but for this it is not improbable that there would have been no fatalities It is also definitely established that the loss of control during these phases was not due to any failure of the structure of the airship, or of the control gear

The primary cause of the accident was heaviness, which could only have been due to abnormal loss of gas This loss was twofold First, the bags had already given trouble by holing, due to rubbing against protruding points on the framework This was due to the wiring round the bags, by which the framework of the ship is slung to them parachute fashion, having been let out in order to accommodate larger bags and give extra lift This had been dealt with by padding the fouling points, but the Report makes it clear that the inspectors were by no means happy about it Secondly, there was probably a complete deflation of one of the larger forward bags, due to the "buffeting that it would receive in consequence of a tear in the outer cover" Exactly how much either one of these is contributory to the other is not suggested in the Report There might also have been an additional loss of gas through the gas valves, which were of novel design, if the ship had rolled excessively--and there had been expressions of opinion that *R101* was prone to rolling in rough weather

If this theory is accepted, it fully accounts for the unmanageability of the ship, and the suggestion that the height coxswain, only on duty a few minutes, had not had time to get the 'feel' of the elevators, while it is probably true, seems to have little to do with the real cause of the disaster In this connexion, it appears that the ship was always sluggish on horizontal control, as it came out of a dive much lower than was intended at the Hendon Air Pageant This was before the ship was lengthened, so that afterwards it was probably even worse, and the man in charge must certainly have known this

The other part of the Report, dealing with the responsibility for taking decisions as to making certain flights, has no direct scientific interest, but indirectly it provides damning evidence of the danger of the system of control of expenditure upon experimental work that is based upon the principle that work cannot "be proceeded with until the existing outlay is seen to be justified by results", o that such work must be held to an estimated time or expenditure The Report makes it only too clear that the decision to undertake the flight to India, and by inference *R100*'s Canadian flight as well, at a time when it was politically expedient, was very largely influenced by the necessity to rehabilitate the airship policy when it was becoming somewhat discredited owing to its continued failure to give spectacular performances

The Report is now public property, and as it has already been stated in Parliament that the decision upon the continuance of airship development was awaiting this, it would appear to be reasonable to examine the present position We have now the sister ship *R100* laid up at Cardington Two ships were purposely built in order that "accidental failure of one ship should not terminate the whole programme" The Report makes it clear, in fact it emphasises, that there was nothing fundamentally wrong with *R101*, either in general principles or structural design Logically, therefore, the experiment should proceed. We ought to be able to avoid a repetition of this catastrophe by taking precautions suggested by the various decisions in the Report Most of these are only too obvious now

A non-inflammable gas must be used This is a pity, as there was a distinct promise of success for a scheme for burning hydrogen in conjunction with the atomised oil in the engine This was a considerable economy, as it would derive power from the gas which has now to be deliberately thrown away as the ship becomes lighter, as fuel is consumed It is, however, inevitable, as the accident to *R101* would have been nothing like as serious had it not been followed by the instantaneous ignition of the gaseous mixture around the torn bag

Spectacular long distance flights must never be undertaken for psychological reasons alone The necessity for completing an advertised programme imposes upon the experimenter an extra anxiety that is quite unfair It is legitimate to suspect that the "very alarming experience when over the St Lawrence River" with *R100* nearly resulted in a similar tragedy The chafing of the gas bags and their consequent excessive leaking and weakening was the result of reducing the clearances between them and the frames to an amount that

was less than the designers originally thought safe This was only necessary in order that the long flight to India might be undertaken The introduction of the extra length must have made some difference in the handling of the controls, which could only have been mastered by the several watches of helmsmen after a long series of flights in all kinds of weather, under the easier conditions of mental strain that would prevail on an ordinary practice flight, in daylight, over familiar country, and without distinguished passengers on board

The question of the time taken to swing the controlling surfaces over by hand appears to need very full investigation The servo-assisted controls were removed in order to save weight, only after what would certainly have been full consideration of all the circumstances It should be possible to deal with this problem by some system of gyroscopic control which would anticipate movements of the ship's bulk from the normal, rather than wait for these to be read by a helmsman and then corrected, even with mechanical assistance

All ballast should be capable of being jettisoned immediately by the person in charge in the control room Such decisions have to be made and acted upon instantaneously If it is of any value to release the contents of a certain tank, that value is largely nullified if the commander has to come to the decision some minutes beforehand, in order to dispatch a man to perform the operation

The technique of emergency landing on the ground or water should be developed as part of the routine handling There does not appear to have been any concerted action of this kind in this case The handling of the ship in the last dip was obviously correct, and established the competence of those in charge at the time beyond all question, and but for the failure to release the front ballast in time, she would probably have gently stranded in a horizontal attitude It is significant, however, that both Disley and Church, who were called upon to perform the vital operations of cutting off the electric current and releasing the emergency ballast respectively, were off duty at the time, and would probably not have been so luckily available had the accident not have happened immediately after the changing of the watch That it is possible to land a large airship on the ground under normal conditions, as would prevail when doing such manœuvres for practice, has been proved by the *Graf Zeppelin* upon many occasions

The broader question as to the advisability of continuing airship development at all, also must be considered Here we cannot lose sight of the fact that there are two distinct outlooks, the war and the commercial uses It is certain that for patrolling the high seas the airship is quicker, cheaper, and has a wider range of vision than any surface vessel Its flying range is also greater than any heavier-than air craft Its relative unwieldiness, and consequent vulnerability to attack, must be put on the opposite side of the scale in judging its usefulness, but the exact balance between these cannot be judged by the layman It is certain that the distinctly naval type of airship development was only given up for reasons of economy, and the continued interest of the fighting services in them is proved by the fact that experiments upon releasing and picking up of fighting aeroplanes from airships have been carried out quite recently

Commercially, it is certain that their large size gives them an advantage over heavier than-air craft from the point of view of passengers' comfort, both for steadiness and room to move about The relatively small aeroplane will always be at a disadvantage in this respect, as even if worked in relays, the passengers' physical endurance will place a definite limitation upon the length of journey that they can undertake On the other hand, it is equally certain that until experience has proved that such a holocaust as the loss of *R101* is no longer to be feared, insurance rates alone would make the use of airships commercially impossible

There is a school of thought that now feels that we have contributed our quota to airship development for the present, and as larger airships are being built in the United States, and projected in Germany, we might stand aside and watch those for a period There are points in favour of this outlook, in that it is impossible to hide general results that are attained, even if it is desired to do so, a state of affairs that there is happily no reason to anticipate at the present On the other hand, there is that somewhat intangible confidence that comes with actual experience in design, building, or handling, that no interchange of written matter can ever give to a personnel It has been announced that a Government statement on policy with regard to airship development in Great Britain is imminent The points we have raised should be given due weight with considerations of economy, unemployment, and other more widely appreciated aspects of the problem

Constructive Excavation

The Palace of Minos a Comparative Account of the Successive Stages of the Early Cretan Civilization as illustrated by the Discoveries at Knossos By Sir Arthur Evans Vol 3 *The Great Transitional Age in the Northern and Eastern Sections of the Palace the most Brilliant Records of Minoan Art and the Evidences of an Advanced Religion* Pp xxiv + 525 + 24 plates (London Macmillan and Co , Ltd , 1930) 105s net

SIR ARTHUR EVANS began to excavate at Knossos in the winter of 1899–1900, and his annual campaigns have been almost without intermission, except during the War The first volume of this account of the results appeared in 1921, the second in 1928 , and there is still to be a fourth, and the much-needed index besides Even this, however, apparently, will only bring the story of the Palace down to the moment of its destruction What happened after that "final catastrophe" is nevertheless part of the history of the site, and an important phase in the transition from Minoan to classical Greek civilisation and it is to be hoped that, in some way or other, the very large mass of evidence which the site affords may eventually be made available, however inferior in artistic performance the later occupants may have been

The account of the successive systems of Minoan writing, to which occasional allusion is made here, is likewise reserved for the second and third volumes of "Scripta Minoa", of which the first was published in 1909

Following the convenient general programme, adopted in vol 2, of an orderly progress through the Palace buildings, the present instalment leads us first (§§ 68 74) through the "North west Insula", north of the central court and west of the seaward entrance , next (§§ 75-7) to the "North Entrance" itself, with its flanking porticoes and fragmentary reliefs of bull-hunting scenes , and then southwards along the east side of the central court, past the "East Postern" (§§ 78-9), and "Corridor, Portico, and Stairs" (§ 80), into the "Domestic Quarter" (§§ 81-2) with its "Hall of the Double Axes" (§ 83), "Queen's Megaron" (§ 84) and "East Treasury" (§§ 85-7) finally (§§ 88-9) the construction and relief-fresco decoration of the "Great Hall" take us above the "Domestic Quarter" back to the level of the Central Court For the whole of this eastern wing of the Palace lay deeply plunged in the steep eastern slope of the neolithic 'tell' on and around which the later structures were accumulated a protected position which accounts in great measure for the remarkable state of preservation in which the lower floors were found Of the "Great Hall", indeed, only a few blocks can be identified , but this stood on top of no less than four stories of corridors and chambers, connected by staircases, ventilated and fairly well illuminated by light-wells, and supplied by gravity with water from cisterns or conduits somewhere up aloft

It is necessary to insist on this elaboration of structure to appreciate the extent to which excavation has had to be supplemented here by thorough and durable reconstruction Minoan builders made much use of timber framing as well as of posts, lintels, jambs, and floor joists When the Palace was wrecked, these lasted long enough to allow rainwash and debris to fill completely the lower rooms and a good part of the first floor But in time decay set in , floor slabs settled down on the filling below them , but lintels and timber-courses left cavities and disintegrated walling, which only remained erect because it could not fall sideways The risks, as well as the problems, of excavation must have been serious , and it was only when the same Cretan climate began to attack modern substitutes, that timber gave place to iron girders, and iron in turn to ferro-concrete (p 288), strong enough, as the event showed, to resist even so severe an earthquake as that of 1926 Through this chapter of accidents, Knossos opens a new period of the scientific exploration of antiquity, and Minoan civilisation becomes appreciable as an organic whole, as Græco Roman life is revealed in the *nuovi scavi* at Pompeii

These architectural discoveries are, however, only the plot or framework of the narrative Borrowing a literary technique, rather from saga than from the modern novel—for the topics and episodes outnumber those of the "Old Wives' Tale"—Sir Arthur Evans has succeeded with remarkable ingenuity in communicating, as he leads us round his Palace, the kind of incidental commentary on the contents, as well as the framework, which a Minoan occupant and connoisseur might have given to a guest from contemporary Mycenæ Room by room, something strikes the attention—as it struck the spade—and halts the party In the "Corner Sanctuary" (§ 69) it is the spiral fresco on the ceiling and the lifelike miniature painting on the walls, earlier, of course, than the furniture, which has been accumulated gradually since the room was last decorated and this leads on to dance-scenes and occasions for dancing, through the ages, to the *pentozális* and *sigandós* which they are going to dance in Cretan villages in the twentieth century—and

with much the same song accompaniment, for all its Venetian name, and so on to siege scenes and the silver cup from Mycenæ, to comparison between fresco painting and the 'metal painting' of the 'lion-dagger', and the Homeric 'Shield of Achilles', to religious scenes and the 'Ring of Nestor'

Through all this, one recurrent thought leads on to the supreme instance of such dependence of Minoan *bijouterie* and *klein kunst* on inspiration from the Palace frescoes and reliefs, namely, the bull hunting scenes of the North Entrance, all but vanished, yet perpetuated in the 'Vaphio cups' (§ 75) and the British Museum's fragments from the Treasury of Atreus (§ 76), and we come to know what is lost, the more vividly, through discussion (§ 77) of the technique of the Minoan 'taureador', so far beyond that of modern 'rodeo' experts, yet surely vouched for by the consentient evidence of scores of episodes, on gems and other works of popular art There is still a good deal to be made out about the details Figs 150 and 158, for example, tell more than even Sir Arthur has seen

Similarly, the wonderful ivory figures from the "East Treasury" (§§ 86-7) lead to reconstruction of what must have been a superb Minoan plaything—if indeed it was not of more solemn use—and to the identification of the "Boston Goddess" and her 'migrated' Boy God, as central pieces from this composition Without necessarily accepting all that is suggested about the "older matriarchal stage of social development", we have here, at a very high power, religious beliefs and feelings about the order of Nature and its meaning for social beings, and remarkable anticipations of elements and incidents in Christian legend, to which, as might almost have been foretold, the mysterious gold rings of Thisbé are principal contributors To the history of these rings, Sir Arthur has a little more to add (p 471), and a notable corroboration of one of the queerest of the topics on them He has also valuable confirmation (p 420) of the authenticity of the "Fitzwilliam Lady", if her actual bully-beef complexion was meant to be powdered and rouged Will Sir Arthur essay reconstruction here too ?

It is only because such a volume as this is not likely to be reprinted that a few slips of the pen are noted in conclusion On p 258 (l 6 from bottom) 'later" should be "earlier", on p 289, n [2], N W " seems required by the context, on p 183 l, "1906" should be "1896" p 323, "convex" fluting should be "concave", p 386, the monolith bathroom is at Tiryns, not Mycenæ, p 391, "Margaret" should be "Harriet", p 439, l 40, "of" should be "by", p 525, l 23, "about" should be "above" and Fig 307 is more nearly double than treble scale JOHN L MYRES

Geological Survey of the Scottish Coalfields

Geological Survey, Scotland The Economic Geology of the Ayrshire Coalfields Area 3 *Ayr, Prestwick, Mauchline, Cumnock, and Muirkirk* By V A Eyles J B Simpson, and A C MacGregor Pp viii + 175 + 3 plates (Edinburgh and London H M Stationery Office, 1930) 4s net

THE Geological Survey of Scotland is continuing the excellent work which it has commenced in issuing memoirs describing in detail the geology of the districts of economic importance, more particularly of the various coalfields Whatever faults may be found with this work of the Survey, it cannot be accused of undue haste, for the immediate precursors of the present volume were published so far back as 1925 The present memoir is the third of the series which has been issued under the general title "Economic Geology of the Ayrshire Coalfields" The first two of these dealt with north Ayrshire, whilst the present volume deals with the northerly portion of central Ayrshire

The work is very complete, the first chapter is a general one dealing with the general geological succession of the area and giving a sketch of the geology of the district It is shown that although important coal seams occur in the Carboniferous Limestone, more especially in the central group of the three into which this series is divisible, the most important division from the economic point of view consists of the Coal Measures These are divided into two groups, the so called barren red measures and the productive measures, which overlie the former group In these red measures, coal is practically absent, except for a few thin seams towards the base of the group Its dark beds, frequently dark red or purple as their name implies, form a very distinct contrast to the grey, or at any rate light coloured, beds of the productive coal measures The New Red Sandstone overlying the barren red measures is briefly described, as also are various intrusive igneous rocks, whilst the superficial recent deposits are briefly referred to It may be noted that this preliminary chapter closes with a few historical notes of very decided interest in the economic history of Great Britain

The next chapter describes the Pre Carboniferous

rocks, namely, the Silurian and Old Red Sandstone, and the following chapter is devoted to the Calciferous Sandstone, which here forms the lower part of the Carboniferous series. The next four chapters describe in detail the Carboniferous Limestone series in different portions of the area discussed, describing in detail the Lower and Upper Limestone group and more particularly the Limestone Coal group in each section. The presence of ironstone is more than once referred to, but it is, unfortunately, only too evident from the descriptions given that the ironstone of this portion of the coalfield is practically worked out. The next chapter describes the Millstone Grit in quite sufficient detail, and the next five chapters are devoted again to a description of the Coal Measures in various sections of the area here discussed, special care being taken to describe the igneous intrusions in each case.

The following chapter deals with a very interesting subject, namely, the Permian rocks of the Mauchline Basin and the coalfield concealed under these rocks. The authors conclude that there is no doubt that a very large field of unworked coal exists within the coal measures concealed beneath the Permian rocks, and that it is very probable that three important seams occur in workable thickness throughout the greater part of this concealed coalfield. It is shown that all the seams are likely to be thickest in the south-east, where they lie at distinctly greater depths than at the other end of the coalfield. The authors consider the possibility of some of the coal being more or less burnt by igneous rocks, but hold that the chances of their being thus burnt are considerably less on the east and north sides than on the western side, and they therefore conclude that it will probably be more profitable to open this concealed coalfield from the south-east rather than from the north-west.

There is a very short chapter dealing with superficial deposits, which are here of very little importance, whilst a final chapter is devoted to other minerals of economic importance, namely, building stones, road stones, etc., clays of various kinds, barytes, ores of lead, iron, copper, and antimony, and graphite, whilst finally a few words are devoted to what has been described as a deposit of china clay. It can only be said that this last section rivals the famous chapter on "Snakes in Ireland". In an appendix there is a short glossary of the mining and technical terms used in this memoir, which will no doubt be found useful. It may, however, be suggested that a comprehensive glossary dealing with the whole series of the Ayrshire coalfields, or even with the whole of the Scottish coalfields, might be preferable, would save a large amount of needless repetition, and would probably be more generally useful.

Like the rest of the series, this volume is well prepared and illustrated by a number of plates and figures. The work was undoubtedly worth waiting for, but it is difficult to see why the period of waiting should have been so protracted.

Blast Furnace Practice

Blast Furnace Practice. By Fred Clements. Vol. 2: *Design of Plant and Equipment.* Pp. 509. Vol. 3: *Operation and Products.* Pp. 400. (London: Ernest Benn, Ltd., 1929.) 63s. net each vol.

WITH the publication of these two massive volumes, Mr. Clements has completed the task which he set himself, of presenting a complete account of modern blast furnace practice based on a comparison between the principal plants in Great Britain and abroad. The amount of labour involved has been very great, and all metallurgists must be grateful for the mass of data thus made available, and for the pains taken by the author to present them in the form of tables and diagrams. The folding tables contained in pockets at the end of each volume in themselves represent an enormous labour, and provide a comprehensive survey of existing practice. Such surveys are naturally soon out of date, as furnaces are continually being rebuilt, and some alteration of practice is sure to occur. On the whole, however, blast furnace practice remains, except for minor details, comparatively unchanged over long periods, although practice in different countries varies widely. Moreover, in spite of the frequent announcements of the success of various direct methods which are to supersede the blast furnace, there is no immediate indication of iron or steel being made from the ore in any substantial quantity without passing through this apparently crude but nevertheless efficient apparatus. This work, therefore, the most complete yet attempted on the subject, is likely to be useful for years to come.

The second volume is concerned with the actual construction of the furnace, the character of the lining, the appliances for charging and for handling the iron and slag, and also with the subject of the blast and the stoves and blowing engines. The drying of the blast, by means of silica gel, which one might expect to find here, was actually described in the first volume. There is, indeed, a certain arbitrariness in the arrangement

of the matter, and as each volume has a separate index, it occasionally needs a little trouble to find information on a point which does not have a chapter to itself The third volume, for example, opens with chapters on the calculation of the burden and on the control of temperatures, followed by others on operating problems, but chapters on economics and on such minor subjects as the provision of ambulances and welfare work are interposed between these and the later accounts of the cleaning of blast furnace gas and the utilisation of by-products Within the limits of each chapter, however, the arrangement of the matter is usually logical, and the expression is clear throughout, the writing being pleasantly free from the jargon too commonly found in books on a highly technical subject The admirably clear diagrams, again, are a feature which cannot be too highly commended

As was remarked in the review of the first volume, the weakest part of the work is its treatment of the chemical reactions in the furnace This defect is also seen in the last volume, in the account of the use of slag for the manufacture of cement, where it would have been interesting to see references to modern work on the nature of cements, on which a very extensive literature exists The utilisation of slag is a subject of great importance Where the texture of the slag is such as to make it suitable for use in tar macadam roads the problem has been solved, but not all blast furnace slags have such a texture, and the manufacture of cement provides a possible outlet, the high qualities of a properly made blast furnace Portland cement having been amply demonstrated

Chemists should find much to interest them in a study of the blast furnace, in which a number of balanced reactions of a complex kind proceed continuously on an enormous scale The work of Bunsen, Playfair and Lowthian Bell placed that study on a scientific basis, but it has been strangely neglected since, although many laboratory studies of the simpler reactions between the oxides of iron and those of carbon have been undertaken The recent work of Bone has shown how remarkable are some of the reactions, and how fully they deserve the attention of chemists The elaborate treatise of Clements will furnish them with ample information as to the conditions under which those reactions proceed on the large scale, and much that is suggestive should be found in its pages The practical metallurgist, on the other hand, will value a work which, if showing some minor defects, has the great merits of clear presentation and remarkable thoroughness

C H D

Our Bookshelf

Photographisches Praktikum für Mediziner und Naturwissenschaftler Herausgegeben von Dr Alfred Hay Pp x + 531 + 3 Tafeln (Wien Julius Springer, 1930) 39 gold marks

THIS handbook is the work of sixteen contributors, each dealing with some application of photography in medical and semi medical work The range covered is very considerable and dealt with in great detail The illustrations are very well reproduced, as might be expected in such a book, but do not occupy an undue proportion of the space It is sometimes urged against photographic recording that the final result often exaggerates unwanted detail and suppresses the points required It is true that the camera and plate are not capable of selecting intelligently what the observer wants, but a study of this volume shows that a great deal can be done to attain this end

Besides chapters devoted to record work pure and simple, such subjects as the electrocardiograph, the photographic recording of muscle movements, and the photographic side of X ray work are dealt with

The work is concerned primarily with medicine and the related sciences and indeed it is rather difficult to justify the ' Naturwissenschaftler " of the title This is apparently the reason for there being no mention of the photographic plate as a measuring instrument The technique of photographic photometry is very complex as so many precautions are essential before the density of the image can be relied on as a measure of the intensity of the incident radiation

The volume is essentially a practical handbook for use as reference, but the two first chapters are devoted to the optical basis of the camera and the physical and chemical properties of the light sensitive material respectively The latter is written from a practical point of view, and is little more than a series of directions No attempt is made to explain the reactions of silver bromide which have been discovered in recent research This is to be regretted, as much of this work throws considerable light on the questions of exposure, development, etc Photography has developed so long on purely empirical lines that it is still not realised that there is a substantial basis of theoretical knowledge which can be of value in most practical applications

A Practical Treatise on Single and Multi Stage Centrifugal Pumps By Raymond Defeld Translated by C W Olliver Pp x + 221 + 42 plates (London Chapman and Hall, Ltd , 1930) 21*s* net

To the British manufacturer of centrifugal pumps, as well as to the student who is specialising in the subject, the appearance of the translation of a volume written by a leading technical official of a well-known Continental firm can scarcely fail to be of interest, if only for the opportunity it should afford of comparing British and foreign practice in various points of detail and design The author is chief engineer of the Ateliers de Constructions

Électriques de Charleroi, more commonly known as the A C E C, and he is also professor of hydraulics at the University of Charleroi two outstanding qualifications which should admirably equip him for the preparation of a manual of sound practical value

The translator's preface claims that Prof Defeld has made a life study of the problems connected with centrifugal pumps So much, indeed, may be readily conceded, and the volume is welcome as the contribution of an acknowledged expert It is received as a standard work in Belgian universities At the same time, without being unduly captious, perhaps we may be permitted to suggest that, as a treatise, the treatment is somewhat uneven and the style concise to the point of abruptness The book, in fact, may not inaptly be described as a specialised note book, better suited for reference purposes to the expert and advanced student than for guidance to the beginner, despite the fact that the leading principles of the subject are demonstrated, though somewhat summarily, in the early chapters As might be expected (though the feature has obvious drawbacks), the illustrations, which are very profuse and not free from redundancy, are chiefly drawn from the products and installations of the A C E C The translator has provided what seems to be a very satisfactory rendering, and the publishers have produced an attractive volume

B C

Grundlagen der Analysis (das Rechnen mit ganzen, rationalen, irrationalen, komplexen Zahlen) Ergänzung zu den Lehrbüchern der Differential und Integralrechnung Von Prof Edmund Landau Pp xiv + 134 (Leipzig Akademische Verlagsgesellschaft m b H, 1930) 9 80 gold marks

Many books on analysis have an introductory chapter on the elementary theory of number, but it is rarely sufficiently detailed to provide a complete logical account based on a few clearly stated axioms The present work by the eminent professor of mathematics at the University of Göttingen occupies a unique position in so far as it aims at giving a rigorous and complete deduction of the properties of numbers, up to and including complex numbers, from the five axioms of Peano, and that, too, by elementary methods, such as a student should be able to understand at an early stage of his university course

There are five chapters, dealing in succession with natural numbers, fractions, sections (*Schnitte*), real numbers, and complex numbers Each chapter gives, in strictly logical order, the definitions and propositions requisite for the proofs of the theorems concerning the application of the fundamental arithmetical operations of ordering, addition, and multiplication to the numbers with which it is concerned The last chapter, in addition, gives the definitions and theorems relating to subtraction and division and to sums, products, and powers of complex numbers The book undoubtedly fills a gap in the list of mathematical books, and should prove exceedingly useful to every reader who feels the need of a clear and rigorous foundation for mathematical analysis

Systematic Crystallography an Essay on Crystal Description, Classification and Identification By T V Barker Pp xi + 115 (London Thomas Murby and Co, 1930) 7*s* 6*d* net

It is clearly desirable, whether one looks forward to the use of goniometric methods as an everyday means of identification or not, that a research worker in one laboratory should issue the results of his study in exactly the same form as an independent worker in another But in the anorthic system, the odds against an identical treatment, even in relatively simple cases, are at least fifty to one Yet it requires only a little care in the choice of the simplest possible indices, aided by a few rules and conventions no more unreasonable or difficult to remember than the convention that the axial angle β of a monoclinic crystal is the obtuse angle, and the odds may be reversed The necessary rules, and the method of their application, Dr Barker has set forth clearly Once given the uniformity of description which would be consequent on a universal adoption of this system, the preparation of determinative tables of crystals, classified by their angles and symmetry, is relatively simple, and a specimen of such a table is given, covering some hundred substances That such tables are of practical value is shown by Dr Barker's successful identification of nine substances chosen from this hundred, by their aid alone It is perhaps not too much to suggest that it is the duty of every crystallographer to study and adopt the proposed conventions—or to put forward better ones instead

Air Ministry Meteorological Office British Rainfall 1929 the Sixty ninth Annual Volume of the British Rainfall Organization Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1929, as recorded by over 5000 Observers in Great Britain and Ireland (M O 325) Issued by the Authority of the Meteorological Committee Pp xix + 298 + 4 plates (London H M Stationery Office, 1930) 15*s* net

This volume, the sixty ninth of a valuable series, gives a full account of the rainfall of the year 1929 on the basis of records from 5180 stations It includes maps, tables, and descriptive matter showing the distribution of rainfall each month and for the whole year and its relation to the average, together with studies of heavy falls of rain on particular days, of the number of days with rain, and of well marked spells of wet and dry weather during the year There are also records of evaporation and of percolation through the soil

The period from January to September was drier than any similar period in the last sixty years, but that from October to December was the wettest on record for the period In fact, an enormous quantity of rain fell during this period in the south-west of England and South Wales

A short article at the end of the volume deals with the rainfall of Pembrokeshire, and there is another special article on the shielding of rain gauges.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Magnetic Hysteresis on Weber's Theory

IN his recent valuable review of the development of the subject of magnetism in discontinuous media [1] Prof. McKeehan makes the statement that the theory, as given in the papers to which he is there referring, "makes no provision for that magnetic hysteresis which is the distinguishing feature of ferromagnetism." This statement is literally quite correct in so far as there was no attempt made in these papers to deal with the subject of hysteresis. But it would be misleading if it were taken to imply that Weber's theory cannot give an account of the phenomena of hysteresis. The existence of directions of equilibrium for magnetisation, alternately stable and unstable, under the Weberian internal field, compel phenomena of that type.

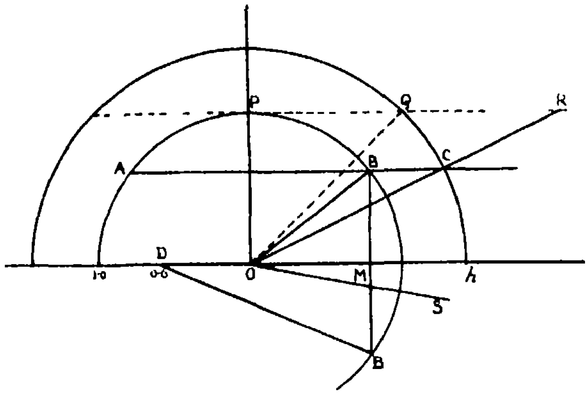

FIG. 1.

A complete discussion, even for the most important case of cubic crystals only, though of great interest, would be unsuited to the columns of NATURE, yet sufficient evidence as to the general validity of the theory may be afforded by the accompanying diagrams, which refer to magnetisation parallel to a face plane of a cubic crystal.

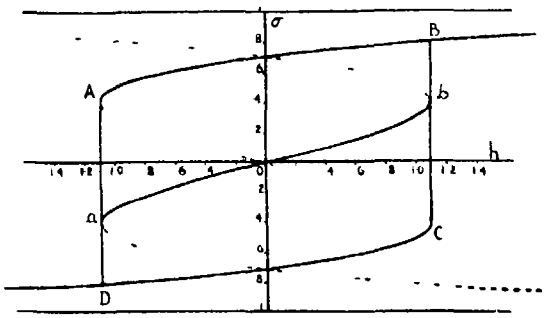

FIG. 2.

Fig. 1 shows a simple geometrical construction which is applicable to this case. The two circles have radii 1 and h respectively, where h is the magnitude of the external field expressed in terms of the maximum value, taken as the unit of field strength, of that component of the internal field which is transverse to the direction of magnetisation. The lines PQR, ABC, and Oh are all drawn in the direction of magnetisation, and OS is in the direction of a crystalline axis of stable magnetisation. If $hOS = \theta$, and $OBA = 4\theta$, while OC is in the direction of the external field, with $COS = \theta_0$, the construction gives $OCA = \theta_0 - \theta$, and corresponds to stable magnetisation. DB' represents the internal field, the component MB' of which is

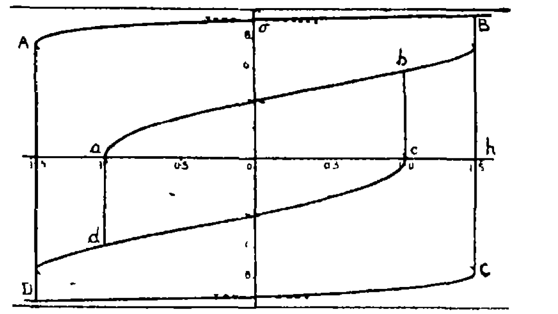

FIG. 3.

balanced by the component MB of the external field. OM gives the fractional magnetisation, σ, in the direction of the external field. If h be increased so that OC becomes OR, we have $\theta = \pi/8$, and instability is just reached.

In Fig. 2 the curve of magnetisation $BAOCD$ is shown for the cases $\theta_0 = 0$ and $\theta_0 = \pi/4$, the equation being

$$h = 4\sigma(1 - 2\sigma^2).$$

The curve for the reverse field is also shown. Unstable stretches are dotted and the hysteresis loop is $ABCD$. So long as h remains less than 1·1, hysteresis does not appear.

In Fig. 3 similar data are exhibited under the condition $\theta_0 = \pi/8$, the equation being

$$h = \frac{1 - 8\sigma^2(1 - \sigma^2)}{\sqrt{1 - \sigma^2}}.$$

So long as $h < 1$ no hysteresis appears. If $h > 1 < 1{\cdot}466$ approximately, the hysteresis loop is *bacd*, and the magnetisation oscillates in direction between the two mutually perpendicular axes $\theta = 0$, $\theta = \pi/2$. If h exceeds the preceding upper limit, the hysteresis loop $BADC$ is described, and the direction of magnetisation oscillates between $\theta = 0$ and $\theta = \pi$.

These results apply under the presumptions that there are no thermal motions, and that the atomic magnets can be regarded as ideal.

W. PEDDIE.

University College, Dundee,
Mar. 21.

[1] Review of Modern Physics, 1930, p. 492.

Absorption Spectra of Saturated Chlorides of Multivalent Elements

FRANCK and his co-workers have shown that the vapours of alkali halides show a continuous absorption spectrum beginning from a long wave-length limit and extending towards the ultra-violet. He interpreted the absorption spectrum as follows: if we take a substance like sodium chloride the valency electron of Na in the normal state may be supposed to pass over completely to Cl and the combination consists of Na^+Cl^-. Such a combination is called ionic. When light falls on sodium chloride vapour, the electron passes over from Cl^- to Na^+, the molecule thus splitting

into Na and Cl Franck obtains the heat of formation Q of NaCl from atomic Na and atomic Cl with the aid of a Born cycle and finds that $Q = Nh\nu$ where ν = frequency of the beginning of continuous absorption

The absorption spectra of saturated halides of multivalent elements have been studied in this laboratory for some time past, and yield results of general interest The chlorides of tetravalent elements, CCl_4, $SiCl_4$, $TiCl_4$, and $SnCl_4$, are the easiest to investigate, because they are usually fluid, and vapour can be obtained with the greatest ease We found generally that these chlorides, like sodium chloride, give a continuous absorption beginning from a long wave-length limit and extending towards the ultra violet

At first the frequency of the beginning of absorption seemed to have no connexion with the heat of formation in the process $M + 4Cl = MCl_4 + Q$, but it turned out ultimately that $Nh\nu = Q/4$ Thus to take a definite example, in $SnCl_4$ the value of Q in the process $Sn + 4Cl = SnCl_4 + Q$ is found to be 306 gm cal, while the absorption spectrum begins from λ = c 3860, corresponding to 74 gm cal, which is about $\frac{1}{4}$ (306) In CCl_4 absorption begins at c λ = 2400 corresponding to 118 gm cal, while Q is nearly four times as large, namely 464 gm cal, provided the heat of vaporisation is taken to be 282 gm cal as proposed by Fajans

The explanation is quite simple The four chlorine atoms may be supposed to be symmetrically distributed about carbon or tin and the whole energy of formation is equally shared by the four chlorine atoms The effect of light is to remove the electron from one Cl ion to the carbon shell, thus splitting CCl_4 into CCl_3 and Cl

The relation may be expected to be generally true The vapour of the saturated halide of an n-valent atom is expected to show beginning of continuous absorption at $\nu = Q/nh$ where Q is the heat of formation in the process $(M) + n(Cl) = (MCl_n) + Q$ It can be shown from considerations of a Born cycle that

$$Q = \lambda_M + \frac{n}{2}D_{Cl_2} + R - \lambda_{MCl_n},$$

so that
$$\frac{Q}{n} = \frac{1}{2}D_{Cl} + \frac{R}{n} + \frac{\lambda_M}{n} - \frac{\lambda_{MCl_n}}{n}$$

where
$$[M] + \frac{n}{2}(Cl_2) = [MCl_n] + R$$

D_{Cl} = *heat of decomposition of* Cl, and λ_M, λ_{MCl_n} are the heats of sublimation of the element and the chloride respectively These are very often not known But Messrs Deb and Mahanti in this laboratory have extended the investigation to the magnesium and aluminium halides (divalent and trivalent) and have found good agreement with theoretically predicted values provided the assumed values of λ_{MgCl_2} etc, which are yet unknown, prove to be correct But no agreement has been found in the case of $HgCl_2$, which seems to behave like HCl or AgCl, which according to Franck, do not conform to the type called ionic binding, but to atom binding

A K DUTTA
M N SAHA

Physical Laboratory,
University of Allahabad,
Mar 20

Raman Spectra of Crystals

I HAVE been investigating the Raman effect in a number of crystals, using the same method of excitation which proved to be particularly successful with gases [1] The primary source consists of a powerful water-cooled mercury arc which gives an extremely intense and sharp resonance line λ2537 The advantages of this method are (1) the ratio of the intensity of the line λ2537 to the other mercury lines in the ultra-violet is so large that in a spectrogram of moderate exposure all the Raman lines are excited by the former radiation (2) a short exposure is required (10 minutes to three hours), (3) a wide range of frequency shifts is available (about 20 000 cm^{-1}), (4) the exciting radiation can be easily absorbed by a filter of mercury vapour between the substance and the photographic plate, thus allowing the observation of modified frequencies in the immediate neighbourhood of the primary line

In the Raman spectra obtained by this method, many new faint lines are observed in almost any crystal which has been tried and the intense lines can probably be measured with more accuracy than has hitherto been done, on account of the large dispersion which it is possible to use But here I will report only the most interesting new features which have been brought out

I have succeeded in recording the Raman spectra of fluorite and rock salt, which, so far as I know had not been observed before Fluorite gives a Raman shift of 321 5 ± 1 cm^{-1}, corresponding to an infra-red wave-length of 31 1 μ, which is in good agreement with the wave-length of the residual rays, 31 6 μ, and besides this, a group of lines of very large frequency shift, which will be considered later

The Raman spectrum of rock salt is very weak (an eight hours' exposure was required using a crystal 5 cm thick) and shows a very peculiar structure It consists of a continuous band with fairly sharp limits, extending from about 165 cm^{-1} to 365 cm^{-1} Within this band, a rather sharp line appears at 235 cm^{-1} Rock salt, owing to the simple structure of its lattice, possesses only one infra-red reflection maximum at 52 5 μ This does not coincide at all with the frequency of the Raman line

A still more peculiar phenomenon is exhibited by calcite and fluorite These crystals show, besides the ordinary Raman lines a group of lines with a very large frequency shift, much larger indeed than any which has been observed so far in the Raman effect The following table gives the numerical values of $\Delta\nu$ in cm^{-1} (± 2 cm^{-1})

Calcite	Fluorite
7270 3	7255 8
7345 2	7273 3
7395 0	7285 4
7455 5	7297 6

That these Raman lines are really excited by the line λ2537 and not by other lines of longer wave-length, is shown by the fact that they disappear on introducing between the source and the crystal a screen which absorbs the spectrum beyond λ2700 and transmits the strong Raman lines $\lambda\lambda$2967, 3022, 3125 31 Besides this their frequency differences from these mercury lines do not agree with any known Raman shifts

The new lines are weak as compared with the strong Raman lines of smaller frequency shift In the case of calcite, an exposure of about 30 minutes is required to bring them out while one minute is enough for the strongest line, $\Delta\nu$ 1086 cm^{-1}

I have not been able to find a reasonable explanation for these Raman lines It is very unlikely that they should correspond to vibration frequencies of the crystal since such high fundamental frequencies are never found in molecules or crystals, even when containing hydrogen atoms, and the occurrence of higher harmonics in Raman effect without the lower harmonics showing at all seems even more improbable I am rather inclined to attribute the new lines to

electronic transitions, although the existence of such levels in CaF_2 and $CaCO_3$ seems rather strange

I may add that analogous lines have been looked for unsuccessfully in ice, quartz rock salt, gypsum, anhydrite aragonite, and barite

F RASETTI

Physical Laboratory of the University,
Rome Mar 18

[1] *Phys* Rev **34** 367 1929 *Zeits f Phys* **61**, 598 1930 *ibid* **66** 646 1930

Liquid Drops on the Same Liquid Surface

As a confirmation of L D Mahajan's view that water is a suitable liquid for the formation of liquid drops floating on its own surface[1] I can adduce two observations, the first of which is analogous to his observations at Den Kund

For several years I have had the opportunity of observing such floating drops of water in the Strait of Trogir (Trau), on the seaboard of Jugoslavia (Adriatic Sea) When the sea is quite calm, the drops dripping from the oar blades and falling on the surface of the sea, sometimes throw out, from their falling point, one or more such floating drops, which, after a quick motion last for several seconds Such drops sometimes spray from the acute crest of the first of the lateral waves which accompany a steamer in motion The temperature of the sea in such cases was probably 18 23 C

Such floating drops (primary) can be produced in abundance in the following way From a nozzle with a small circular orifice a fine jet of water issues with a moderate velocity and is falling on a surface of water The orifice should be kept at such a height

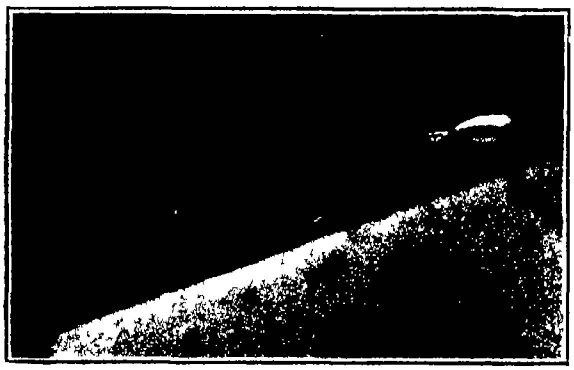

FIG 1 Velocity of efflux 86 6 cm sec, height of jet, 0 7 cm reduction 0 68

above the surface that the jet reaches it in its instability range which lies between the place where its vibrations originate and where it is resolved into drops Then from the point of incidence a great many floating drops are seen moving in different directions, forming a regular fan like pattern The velocities of efflux range from some 250 cm /sec to a few mm /sec In the last case only single drops leave the orifice and form on the surface—either directly or coalescing from two—uncommonly large drops (by estimation up to 6 mm) which last about 3 seconds In my experiments the diameter of the orifice was 0 5 mm , while the height of the falling jet was from 0 5 to 1 5 cm and they were performed at room temperature

The smaller the terminal angle of the jet or the greater the velocity of efflux the narrower is the fan of moving drops With fairly high velocities and rather small angles (about 45°) the fan grows narrower to some 20° 30° or gets reduced only to one ray of the drops In this case, the greater part of the falling jet reflects in the plane of incidence and forms a low parabola, consisting of dense drops, which, after a renewed fall on to the surface proceed in a straight direction In the case of vertical or nearly vertical incidences and of velocities smaller than 120 cm /sec the fan of the drops comprises 360°, and the drops spray fan like in all directions

The average diameter of a drop is 2 mm It is smaller if the velocity of efflux is greater It lasts, on the average, 2 seconds Single drops, especially

FIG 2 Velocity of efflux 89 1 cm sec height of the jet 1 1 cm , reduction 0 70

those which have returned from the wall of the vessel, lasted up to 5 seconds

The photographs reproduced herewith have been made from a nearly vertical position while the surface of water was obliquely lit by the sun or arc light They represent these drops in motion (time of exposure 0 04 sec) An arrow shows the incidence of light Each drop in motion showed above the dark base as a pencil of parallel lines, which corresponds to the optical images, as formed on the drop[2] Three parallel lines regularly correspond to one drop These are well seen on the drops which move more or less perpendicularly to the incident light On the side facing the source of light there appear two lines very near each other, while the third is somewhat farther away Their relative intensities are changeable Often, also the third line is double Bright lines near the point of incidence of the jet usually show a periodical granulation This can be ascribed partly to the vibrations of the drop, owing to which it periodically changes shape partly to the jumpy motion Such granulation is well shown on the under exposed photographs (Fig 2) That these are really drops, and not bubbles can be seen from the fact that they throw a *shadow on to the white part of* the bottom of the vessel

The above described phenomenon can be shown by experiment with both distilled and tap water Success depends on the freshness and cleanness of the surface of the water used Even the least traces of grease make success impossible The very touch of the *surface with the fingers* lessens the range and life of the drops

The drops are not reflected at the wall of the vessel itself, but return before coming to it Drops of small velocity return at a distance of nearly 1 cm from the wall of the vessel This distance decreases with increase in the velocity The drops seem to return owing to the motion along the slope of the surface, which slowly ends in the angle of contact

As to the origin of this phenomenon it should be kept in mind that the jet in its state of instability breaks up into drops on the vibrating surface at the

point of incidence Here the drops reflect in various azimuths, according to the momentary position of that part of the surface on to which they fall

M KATALINIĆ

Physics Institute,
University of Zagreb, Jugoslavia,
Mar 20

[1] L D Mahajan, NATURE, 126, 761 1930
[2] M Katalinić, *Zeit f Physik* 38 511 1926

University Entrance Scholarships for Science

I HAVE read with great interest the recent correspondence in the *Times* on science in scholarship examinations and the comments upon it in the leading article in NATURE of Mar 28 I should like to present a point of view rather different from any which have hitherto been put forward and to support it by a number of facts which, in my opinion, have not yet received the attention which they deserve I believe that the science specialist at school does devote a reasonable amount of time to literary subjects and does leave school with a satisfactory interest in literary culture, whereas the humanist devotes little or no time to the study of science and leaves school with an attitude of condescension towards it, which savours of intellectual snobbery and does little credit to the type of education which he has adopted

In support of this view, I propose to outline the typical preparatory and public school education of both an intending science scholar and a classical scholar The latter usually commences Greek at his preparatory school, so he begins some measure of specialisation at the age of about eleven He then spends the first two years of his public school career on a course of 'general education', which includes six periods a week of Greek and only three periods a week of science Having taken the School Certificate, he then commences specialisation in earnest and the time which he now devotes to science is reduced to one or two periods a week for the rest of his time at school, or perhaps only for the first year of specialisation I should add that, whereas the classic does only three periods a week of science in his course of general education, intending specialists in modern languages or history do some seven periods a week The future science scholar, on the other hand, arrives at his public school having done little or no science and spends his first two years on precisely the same course of work as the intending modern language or history specialist He is, quite rightly, not allowed to specialise at all until he has passed the School Certificate, and even then his course includes some eight periods a week of literary subjects The same thing is also true of the poorer boys, who appear to be the chief concern of the headmaster of Charterhouse, these boys will be at the day schools, and it is laid down in the Board of Education Regulations for Advanced Courses in Science that from one quarter to one third of the time must be devoted to literary subjects I think that the statistics which I have quoted are typical and they show quite clearly that it is the classical scholar who is the real culprit in this matter of premature and narrow specialisation

If we now turn to the attitude shown by the specialist to subjects other than his own after he has left school, I feel that the facts again point the finger of accusation at the humanist rather than the scientist In this respect I would venture to add my testimony to that of Prof A V Hill in defending the interest taken by the professional scientist in art and literature, while the interest of the mathematician in music is proverbial But the classic has little interest in, and perhaps even less knowledge of, scientific culture In fact, so narrow is his interest in even Greek culture, that when the Oxford University Press wish to publish a book on the "Legacy of Greece", they invite scientists such as Dr Singer to write those sections of the book dealing with the distinguished contributions of that civilisation to the various branches of science The headmaster of Charterhouse states in his letter that science is destined to play an ever increasing part in the affairs of the State, and in recent years leading articles in NATURE have deplored again and again the reactionary attitude of the Civil Service to scientific research and its introduction in State departments and the Services It is surely not without significance in this respect that the large majority of Civil servants have had a classical or humanist education

In conclusion, I venture to hope that no more will be heard of the dangers of premature specialisation in science, which, I think I have shown, are grossly exaggerated, but that attention will be turned to the far more urgent problem of ensuring that all specialists in the humanities shall devote at least four periods a week to science For, until this is done, I shall continue to maintain that it is they, and not the scientists, who are the real offenders in this matter of specialisation

A W BARTON

Repton School,
Derby

Conditions of Silver Chromate in Gelatine Hydrolysed and Electrodialysed to Different Extents

IN a series of papers, Dhar, Chatterji and collaborators have shown that if a reaction between two salts giving rise to an insoluble product is allowed to take place in gels, the insoluble substance exists in colloidal condition in the gel and the formation of Liesegang rings is due to the coagulation of the colloid It has been shown, however, by Williams and Mackenzie[1] and Bolam[2] that the insoluble substance produced by the reaction between two salts exists in supersaturated condition in the gel, and their results support the theory of the formation of Liesegang rings proposed by Wi Ostwald[3] Experiments have been carried out by us to study the condition of silver chromate in gelatine hydrolysed (*by heating*) *and electrodialysed to different extents*, by determining the contact potential of pure silver in a mixture of $N/100$ silver nitrate, $N/100$ potassium chromate, and 3 per cent gelatine

So long as the mixture remains yellow and there is no visible precipitation of silver chromate the contact potential remains the same as that of silver in silver nitrate of the same concentration as in the mixture, but with the appearance of the precipitate, the contact potential gradually decreases and tends towards a limiting value The general conclusions from the measurements of contact potential can be summarised as follows

(1) More than 95 per cent of the silver chromate remains in the ionic condition in the gel (2) The power of gelatine to inhibit the growth of crystallisation centres decreases with the progress of hydrolysis (3) The inhibitive power of gelatine increases with the progress of electrodialysis (4) The inhibitive power of gelatine is closely associated with its pH, and the smaller the pH of gelatine the greater is its inhibitive power (5) The solubility of silver chromate in unhydrolysed gelatine is not increased by decreasing its pH (6) The solubility of silver chromate in gelatine increases with an increase in the degree of its hydrolysis

It is also found by varying the concentrations of the reactants (silver nitrate and potassium chromate) that the precipitation of silver chromate follows the usual

rules of solubility product On subjecting the mixture of silver nitrate and potassium chromate in gelatine to cataphoresis, silver chromate formed by the interaction is not found to carry any charge (either in the yellow mixture before the appearance of the precipitate or in the reddish turbid mixture after some precipitate has appeared) These results, therefore, show that most of the silver chromate in gelatine in these experiments is in ionic and not in colloidal condition

Similar experiments have also been carried out by allowing silver nitrate and potassium chloride to react in gelatine It is found that in this case whatever fall in the contact potential is to take place, occurs as soon as silver nitrate in gelatine and potassium chloride in gelatine are mixed, the process not being gradual as in the case of the mixture of silver nitrate and potassium chromate in gelatine Most of the silver chloride in gelatine exists in a condition other than ionic

It is considered that the results obtained from a study of the precipitation of sparingly soluble substances, such as silver chloride, which do not form Liesegang rings in gelatine, should not be applied to explain the condition of sparingly soluble substances, such as silver chromate, which do form Liesegang rings in gelatine There is a difference in the function of the gelatine in the two cases

The results will be discussed elsewhere in detail

G M NABAR
B N DESAI

Physical Chemistry Laboratory,
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India

[1] *Jour Chem Soc* **117** 151 1920
[2] *Trans Far Soc* **24** 463 1928 and **26** 133 1930
[3] *Zeit f physik Chemie*, **23** 365, 1897 Lehrbuch d allgem Chemie , second edition vol 2, p 778 1899

Explosions of Hydrogen Sulphide–Oxygen Mixtures

IN the course of an investigation of the kinetics of the reaction between hydrogen sulphide and oxygen at temperatures just below, and up to, that of ignition, an interesting phenomenon concerning the explosion has been observed, which, although in the light of certain recently discovered chain reactions may not be without parallel, yet seems sufficiently striking to warrant mention here

In a cylindrical glass reaction vessel, 3 5 cm in diameter, hydrogen sulphide–oxygen mixtures appear to ignite above about 220° C , though the ignition temperature of course varies somewhat according to the total pressure and relative proportion of the gases used In a similar vessel, 1 1 cm in diameter, no ignition could be observed at 300° C

In a cylindrical vessel of intermediate size, namely, 1 5 cm in diameter, ignition sometimes occurred using higher pressures at 260° C , but generally not below about 270° C The first fact of interest is that the explosions under these conditions were never complete, although when explosion did occur the oxidation was in accordance with the equation

$$2H_2S + 3O_2 = 2H_2O + 2SO_2$$

An induction period of some seconds (or minutes) always preceded an explosion As an example of this, 150 mm hydrogen sulphide and 300 mm oxygen were introduced in this order into the glass vessel at 280° C After 8 seconds induction period (no pressure change) sudden explosion occurred with a pressure decrease of 45 mm If complete explosion had occurred the pressure decrease would have been approximately 75 mm During the 5 minutes following the explosion a rapid reaction occurred with 30 mm pressure decrease In this way the hydrogen sulphide surviving the explosion was finally burnt up in a rapid change On the other hand, if the oxygen–hydrogen sulphide ratio is increased the rapid reaction following the explosion may give way to additional explosions Thus at 280° C :

(1) Hydrogen sulphide, 100 mm , oxygen, 400 mm

0 m	3 s	exploded	25 mm	pressure decrease
0	8	exploded again	15 mm	,, ,,
0	15	,, ,,	10 mm	,, ,,
		Total	50 mm	pressure decrease

(2) Hydrogen sulphide, 196 mm , oxygen, 404 mm

0 m	5 s	exploded, 25 mm pressure decrease	
0	15	exploded again, 16 mm pressure decrease	
0	20	measurable reaction starts	
0	50	additional pressure decrease	10 mm
1	27	,	20 mm
2	18	, ,, ,,	30 mm
3	20	, ,, ,,	40 mm
5	35	, ,, ,,	55 mm
		Total decrease of pressure	96 mm

It is very striking that so many as five successive and quite well-marked explosions have been observed with the same mixture, each being preceded by an induction period which lengthens as the mixture is used up The rise in temperature consequent upon an explosion is never more than 1° C

The nature of the phenomenon and the conditions under which it occurs are to be further examined Meanwhile, a detailed report of the characteristics of the reaction as a whole is in the press , in this a closer discussion of the facts is given

H W THOMPSON

St John's College, Oxford,
April 1

Plankton Changes on the Coast of Ecuador

DURING the month of February of this year an unusual phenomenon has been observed in connexion with the coastal waters of the Pacific from the headland of Santa Elena to the north of Esmeraldas, Ecuador

The normal blue and clear waters of the ocean along the littoral zone have been replaced by turbid, yellowish brown lenses of water which emit a most disagreeable and fœtid odour, suggesting stagnant swamp conditions These discoloured patches, which occur not only along the shore-line but have also been reported in the steamship lanes from Panama southwards, indicate that they have been possibly induced by the equatorial current from the north (El Niño) which, at this time of the year, is found in close association with the cooler Antarctic Current (the Humboldt) The latter, as is well known, impinges upon the greater part of the west coast of South America during many months of the year

An examination of the discoloured water under the microscope has revealed the fact that it is full of plankton material (the greater part consisting of spores of marine algæ), and there is no suggestion of mud or other sedimentary detritus

The idea has been put forward that the normal plankton of the Humboldt Current has succumbed owing to the higher temperature of the equatorial current , on the other hand, it is just possible that the sudden increase in temperature of these waters, caused by the influx of the warm water from the north, may have been responsible for an abnormal

fructification of the larger marine algæ, with a consequent dissemination of spores in sufficient numbers to discolour the water Whatever be the cause, however, the phenomenon is unusual, and has never been noticed by me before during eight years' residence in this part of South America

George Sheppard

State Geological Department,
Ecuador, Feb 26

Disease in Nature

In the review of "The Science of Life", by Wells, Huxley, and Wells, there is a statement on p 479 of Nature of Mar 28, "we are prepared to defend the thesis that wild Nature (that is, apart from man's interference) is characteristically marked by exuberant positive health, while in civilised society diseases are rife and sub health is becoming almost normal!"

The statement is very attractive but, in so far as it refers to plants, is erroneous We are only too well aware of the diseases of crops, but the factors which enter into the problem are not sufficiently understood for us to be able to distinguish clearly between the disease of a crop and the disease of individuals It is a truism that there is a greater opportunity for the spread of disease in crops than in Nature, further, until recently, the cultivation of varieties of crop plants immune to a particular disease received scant attention

The suggestion that trees, herbs, and shrubs growing in their natural habitats are invariably in good health is wide of the mark While it is customary to assume the prevalence of fungal attack in tropical vegetation as visualised by popular writers, it is not perhaps realised that British flowering plants, probably without exception, are parasitised by one or more fungi This parasitism is obviously of different degrees of severity, but it is so general that it has to be taken into account in intensive ecological investigation

J Ramsbottom

British Museum (Natural History),
Cromwell Road, London, S W 7,
Mar 30

No one can doubt that infection with parasites and predatory microbes is common in wild Nature, both among plants and animals, but that is not tantamount to saying that disease is common For disease, whether constitutional, environmental, functional, or parasitic, means disintegrative or deteriorative disturbances of the normal balanced metabolism of the organism Speaking of animals some years ago, the late Sir Ray Lankester said that he knew with certainty of only one microbic *disease* in wild Nature—a bacterial disease of sandhoppers Many parasites—if not most—seem to do little harm to their host, unless that becomes somehow enfeebled, for example, by man's over crowding or over sheltering In many cases, the parasite establishes an innocuous *modus vivendi* with its host, though it may become harmful if man transfers it to a new hospitality Moreover, many so called parasites (the concept has become woolly) are really predatory organisms devouring the plant or animal from within, as a beast of prey does from without Such predatory intruders may destroy the victim, but they do not bring about disease All evidence from crops and plantations and the like must be excluded as irrelevant to my point that wild Nature is characteristically marked by exuberant positive health But this is not to be taken as a dogmatic assertion that there is no disease in wild Nature, and Mr Ramsbottom's expert caveat is very welcome

The Reviewer

Extraction of Insulin

In some earlier experiments it was found that insulin was precipitated quantitatively from commercial preparations by means of sulphosalicylic acid and it appeared to us that this fact might form th basis of a method for the extraction of insulin which would obviate the use of large quantities of alcohol

The following is an outline of the technique eventually employed Bullock's pancreas, frozen immediately upon removal from the animal, is minced and allowed to thaw out in about two thirds its weight of 20 per cent sulphosalicylic acid After two hours the whole is filtered in a hydraulic press and the comparatively dry residue covered with acetone and left to dehydrate overnight in the cold The almost water free residue is now extracted in a Soxhlet with acetone and finally dried rapidly in a current of air at 40° The active principle can now be extracted from the powdered fat free residue by 75 per cent alcohol containing about 0 5 per cent of hydrochloric acid The aqueous alcoholic solution of insulin hydrochloride is concentrated in the usual way and the product precipitated with acetone We obtained about 2 gm per kgm of minced pancreas A solution of 0 1 gm of this substance produced, by subcutaneous injection in a 2 kgm rabbit, hypoglycæmic convulsions in five and a half hours

This method, whilst not entirely dispensing with the use of alcohol, requires much less than those in which *fresh* pancreas is extracted We have not explored the conditions for obtaining maximum yield, nor have we the time to do so, but we give the fore going details of a method which, we venture to think, may prove to be of interest to those more actively engaged in the manufacture of insulin

P G Marshall
B P Wiesner

The Macaulay Laboratory,
Department of Animal Genetics,
The University, Edinburgh

Identification of the Plant called 'Narthex'

In Nature of June 21, 1930, p 920, Mr Henry Balfour inquired as to the nature of the plant called 'narthex' by the present inhabitants of Lesbos Through the kindness of Miss Winifred Lamb, who has been excavating there, it has been possible to identify it with *Ferula communis*, which is the giant fennel and, like a reed, has a hollow stem

This, however, does not definitely solve the point at issue Dr G F Hill points out to me that some of the Cyrenaic coins have represented on them a *Silphium*, which is now extinct and which probably also had a hollow stem For further information the Catalogue of the Greek Coins of Cyrenaica (British Museum), by E S G Robinson (1927), p cclı, can be consulted

N Eumorfopoulos

University College,
Gower Street, London, W C 1

The definite identification of νάρθηκα, as used by modern Lesbians, with the giant fennel, *Ferula communis*, is interesting, and seems to dispose of Theodore Bent's identification of it with a reed The dry pith inside the fennel stalk would, when ignited, continue to smoulder gently inside the protective casing of the stalk, which would prevent the wind causing the pith tinder to be too rapidly consumed Bent's explanation of the νάρθηξ as serving to prevent the smouldering tinder "being blown out", is clearly erroneous I desire to thank Mr Eumorfopoulos for his note upon my communication of June 21, 1930

Henry Balfour

Isomorphism and Chemical Homology

In Nature of Dec 13, 1930, p 916, is a communication by Prof Willy Lange, of Berlin, referring to a letter by me[1] on this subject The misunderstanding can be easily cleared up Dr P B Sarkar has been working in this laboratory for a long time on the chemical homology and isomorphism of complex ions, and his first paper on the subject, on the homology of fluoberyllates and sulphates, was published in 1929[2] In continuation of this work, and proceeding on the basis of Goldschmidt's principles of isomorphism, he was investigating the possible cases of isomorphism among the inorganic complex radicles or ions It was a pure accident that he should have been working on the isomorphism of monofluophosphates and sulphates when Prof Lange's paper appeared in the *Berichte* of the German Chemical Society As in this paper only the simple monofluophosphates and sulphates were described, and crystallographic investigation only of the same was promised, it was not considered necessary to give up that part of Dr Sarkar's work which dealt with the isomorphism of double monofluophosphates and double sulphates, and even then a year was allowed to pass by in awaiting further communication on the subject by Prof Lange As nothing appeared in the interval giving any indication on Prof Lange's part that he would extend his work in this direction as well, I did not consider it justifiable to withhold the publication of this part of Dr Sarkar's work any longer Prof Lange's petition to the Notgemeinschaft der deutschen Wissenschaft on April 29, 1929, regarding the formation of alums by the fluophosphates did not appear in any scientific journal or abstracts, and hence could not attract our notice

However, I deplore the omission of Prof Lange's name in my note, which was not made with any desire to claim priority, complete recognition of his work will be made when Dr Sarkar's work is published in full

P C Rây

University College of Science and Technology,
Calcutta, Mar 3

[1] Nature Aug 30, p 310
[2] *Jour Indian Chem Society*, vol 6, No 6, 1929 and Nature, Sept 28 1929, 124, p 480

The Karoonda (S A) Meteorite of Nov 25, 1930

Following on my letter of last week [see Nature, Mar 14, p 402] concerning the Karoonda meteorite, I now enclose a brief report by Mr A R Alderman, of the Geology Department, University of Adelaide, giving the results of a petrographical and chemical examination made by him of the substance of the meteorite

The final results of the chemical analysis will not be available for some months

Kerr Grant

The University of Adelaide,
Adelaide, Feb 13

The dark greyish interior of the meteorite consists of a dull ground-mass relieved by numerous black chondrules and spangles of a brassy mineral which is probably troilite (ferrous sulphide) The chondrules are very hard and compact and may quite easily be rubbed away from the friable ground-mass by the fingers

Undoubted metallic nickel iron is present in such small amount as to be indistinguishable in the hand specimen

A rough microscopical examination reveals that olivine is by far the most important mineral in the ground-mass Some hypersthene is also present

The chondrules consist of these minerals with a good deal of glassy material Minute granules of nickeliferous iron are but rarely seen, but grains of an opaque brassy mineral are of very variable size and are apparently troilite

The chemical analysis (not yet completed) is in agreement with the mineral composition Silica is very low, about 34 per cent, whereas in the silicate material ferrous iron is present in greater amount than is magnesia

An accurate estimate of the percentage of metallic material is not yet available, but it seems probable that metallic iron constitutes less (possibly much less) than 0 3 per cent of the specimen analysed Nickel is of the order of 0 03 per cent

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Medicinal Cod Liver Oil

In our recent Report to the Empire Marketing Board on the Relative Values of Cod Liver Oils from Various Sources (E M B 35), noticed in Nature of April 4, p 538, an unfortunate blunder has arisen during the revision and proof reading of the introductory chapter

Reference 6 on page 9 is incorrectly given and should, of course, refer to the important paper by Prof Steenbock and his colleague Dr Boutwell in the *Journal of Biological Chemistry*, vol 42, p 131, 1920

Immediately our attention was directed to the error we wrote to Prof Steenbock expressing our great regret and, although he desired that we should give no further attention to the matter, we feel that we must override his wishes and make public our correction of the mistake

On the same page the reference to Prof E Mellanby's pioneer researches on the causation of rickets might suggest that his results were not published before 1921 We were, of course, well aware of his earlier contributions to the subject but thought it better, in a brief summary, to refer the reader to the full account of his earlier work which was published by the Medical Research Council

We would like to express our apologies to these distinguished investigators

J C Drummond

University College, London

T P Hilditch

University of Liverpool,
Mar 25

Atomic Weight of Krypton

While measuring the dielectric coefficient of a particularly pure sample of krypton, it occurred to me that a density determination would be of interest in view of Aston's recent statement that the accepted value of the atomic weight appeared from his measurements on the relative quantities of the isotopes to be much too low

I made a comparison of the densities of krypton and oxygen by means of the microbalance and found that at 25° the pressures at which the two gases had equal densities were 301 15 mm and 787 8 mm If the compressibility corrections were proportional for the two gases, the atomic weight of krypton would be 83 71, while using the most probable value for the compressibility of krypton which I calculated in 1910, the figure reduces to 83 62

While these results must not be considered final, it appears highly probable that Aston's figure 83 77 is more accurate than the accepted 82 9

H E Watson

Indian Institute of Science,
Bangalore, India, Mar 17

The New Crystallography

By F. I. G. Rawlins

THE attraction which the study of crystals has always exerted, not only upon the scientific worker but also upon a wider circle, is in no danger of abating. The time is perhaps appropriate to discuss a number of developments which have come about during, roughly, the last five years. So far as the crystalline state itself is concerned, the chief change has been one of classification; it is not necessarily the crystal system which determines much of our present-day knowledge, but rather the atomic environment. Thus, in rock salt, each atom (or more strictly, ion) of sodium is surrounded by six ions of chlorine at the corners of an octahedron, and conversely. From the experimental point of view, this advance must be placed to the credit of the X-ray workers; it has only comparatively recently been recognised, however, that upon the structures thus established it was possible to build up a systematic chemistry of the solid state, based upon the conceptions of environment, ionic size, and ionic deformability.

It has come about that a considerable part of the subject of crystallography is concerned with the question: Given the structures of a large and increasing number of elements and compounds, how much can be deduced about their physical and chemical properties? And again, one asks what kind of experiment is most likely to provide this information, and whether it is essential to work with crystals at all in some instances. These queries are easily seen to reduce to this: whether it is desired to know something about the crystalline lattice, or whether it is the components of the lattice that are the more important. Research of the former kind obviously needs actual crystals, whereas the latter may be able to make some progress in states of matter wherein lattices, as ordinarily understood, do not exist: for example, solutions and even gases. Clearly, the new crystallography will trespass upon the preserves of many neighbouring sciences.

The Union of Ions into Crystals.—From a logical point of view, it is not altogether fortunate that so much attention has been given for so many years to the morphology of crystals as such. A more fundamental way to proceed would be to consider a free atom of an element A at some distance from a free atom of some other element X, and to follow the course of events in which all the A's and all the X's are bound so that the assemblage $\Sigma [A, X]$ is in equilibrium, at a temperature such that the components A and X are constrained to fulfil certain definite geometrical conditions with respect to each other. Stability will ensue for that particular configuration of $\Sigma [A, X]$, say $S [A, X]$, for which the energy is a minimum. In other words, the arrangement $S [A, X]$ represents a crystal.

This view has led to some very interesting results in a series of experiments upon the alkali halides. The ionic refractivity, which depends upon the deformability already mentioned, can be measured in the free state, R (free ions), and in the crystalline state, R (solid). Now, cations and anions behave very differently in the presence of each other. Anions are consolidated, or rendered more rigid, by neighbouring cations, because in addition to the attraction of the nucleus of the anion for its own electrons, there is added that of the positive cation. A similar argument shows that just the reverse holds for a cation under the influence of an anion—the distortion or deformability increases. Hence, in the former case the refractivity decreases, and in the latter it rises. Thus the union of ions to form a crystal will bring about a net decrease in refractivity when the consolidating effect of cations upon anions preponderates over the loosening effect of the anions upon the cations, and vice versa. For most of the alkali halides the difference R (solid) $- R$ (free ions) is negative, which corresponds to a net consolidation when the crystal is formed out of the appropriate free ions. Only for potassium and rubidium fluorides (KF and RbF), in which a large ion is paired with a small ion, is a net loosening indicated. A balance is approximately obtained for sodium fluoride (NaF) and rubidium chloride (RbCl): the experimental accuracy is not high enough to detect very small differences in the refractivities.

In aqueous solution the refractivity is found to vary with concentration in a manner which suggests that at high concentrations the ions approach each other nearly as closely as in the crystal lattice; they are in direct contact, with no intervening water molecules. Other examples of relationships between crystals and solutions will occur later; they have been fairly extensively studied by spectroscopic methods.

Crystal Thermodynamics.—Strictly, thermodynamic reasoning is independent of a mechanism, and in this sense its application to crystal lattices and the particles composing them is not very obvious. Nevertheless, an extension of its proverbial boundaries has extended our grasp of the energetics of the solid state. To show how this has happened, two examples, characteristic of the most modern work, will be discussed. In the first, one is dealing with a sub-lattice property, and in the second, with a lattice property. Consideration in this particular order will serve to stress the general outlook of this article; the units composing a crystal are, from this aspect, of prior importance to the particular way in which they may be grouped.

The quantum theory, applied to gaseous molecules, has been fruitful in unravelling the complexities of rotational and vibrational motion. The latter has long been recognised to be characteristic of the solid state also, but it is only very recently that the possibility of molecular rotations in crystals has been seriously considered. The work is for the most part theoretical, and based upon suitable applications of the wave mechanics to diatomic molecules. The wave equation appears in the form of Mathieu's equation, and the corresponding energy levels are generally readily deducible

Analysis shows that two extreme cases may be discerned, one in which the energy equations are those of the quantised harmonic oscillator, while the other approaches the value for the rotator. The next step is to obtain a discriminant, in terms of measurable quantities, for the transition between oscillational and rotational motion. The inequalities

$$n+1<\beta\nu/4\theta \text{ (oscillational)},$$
and
$$n+1>\beta\nu/4\theta \text{ (rotational)},$$

provide, on certain assumptions, the criterion desired, for the quantum state n and frequency ν. The factor θ depends upon the moment of inertia, which is readily forthcoming from spectral data, while β is a constant. Another, and in some respects a simpler analysis, demonstrates that rotation may be expected at temperatures greater than $2V/k$, and oscillation for values less than this fraction (V is a characteristic quantity in the potential function for the particular molecule considered, and k is Boltzmann's constant). The probability that a molecule will rotate is capable of approximate calculation, yielding $P=e^{-2V/kT}$, where T is the temperature.

The expressions in terms of n and θ can conveniently be combined into the equation $n_0+1=\beta\nu/4\theta$, where n_0 is the particular value of n, which is on the borderline between the rotational and vibrational states. For hydrogen (H_2), with its small moment of inertia, $n_0+1\sim 0.4$, whereas for iodine (I_2) $n_0+1\sim 350$. From these figures, it follows that the molecules in solid hydrogen are rotating even in the lowest quantum states, whereas in iodine no molecules are rotating in the crystal, since melting occurs for $n\sim 12$.

The ammonium salts provide an interesting example of substances for which the transition from rotation to vibration may be expected to set in well within the solid range. A temperature of about 240° absolute is indicated by the theory. Observations of the heat capacity as a function of temperature have shown that in a number of substances there is a finite range of temperature over which the relative numbers of molecules in either state is undergoing a progressive change.

The second contribution, already alluded to, concerns the form of the specific heat curve (particularly at low temperatures) as a function of the crystal symmetry of the substance. If one assumes that the usual Debye equation represents the facts for the cubic system, then, as materials of decreasing symmetry are examined, instead of following the 'ideal' curve (convex upwards), an approximately straight line results. The sequence is well seen in the series zinc sulphide (cubic), zinc oxide (hexagonal), cupric oxide (triclinic). The importance of this effect is that the specific heat is influenced by the atomic environment, a typical lattice property.

Crystal Spectra.—As in the thermodynamical matters already discussed, it is convenient to divide crystal spectra into two main classes, those of ionic (or even sub-ionic) origin, and those for which the lattice, or at least parts of the complete lattice, are responsible. In dealing with the former, one is tempted to make a yet finer distinction between the types of spectra in which ions, or groups of ions, are concerned (in contradistinction to the swinging of large portions of the whole lattice), and phenomena which have their seat within the ion itself: that is, transitions of an electronic nature. Spectra arising from these three causes may be expected to appear at increasing wave length as the mass of the unit concerned increases. Thus, sub-ionic (electronic) absorption spectra in crystals may occur in the visible region, and are closely connected with the nature of colour. Inter-ionic spectra are found in the near infra red (between about 1μ and 30μ); lattice spectra are revealed at a wave-length some ten times greater, and are usually detected by the method of residual rays, or some system involving focal isolation. Oscillations of approximately these frequencies are those encountered in the theory of specific heats already mentioned.

In electronic crystal spectra, restricted in the main to salts of the rare earths and those of the transitional elements, one is confronted with a problem of great complexity, intimately connected with electronic levels and the magnetic properties of ions with incomplete electronic shells. There is little doubt that the sharpness of the bands in the visible region is attributable to the high electrostatic shielding and weak coupling between the electrons belonging to neighbouring ions. Information of value to chemists may well be obtained by studies of this kind.

Somewhat similar investigations have produced some illuminating results when the absorption spectrum of an ionic group like MnO_4 is examined in a crystal and in solution. The effect of dissolving, say, potassium permanganate, in water is to slow down the oscillations characteristic of the group, owing to the outward pull of a solvent of high dielectric constant ($=80$): solution in ethyl acetate (D.C. $=6$) allows the MnO_4 group to contract to almost the same dimensions as it has in the crystal lattice of potassium permanganate. In other words, the surrounding molecules of ethyl acetate have much the same effect upon the MnO_4 tetrahedron as the ions of potassium in the solid state.

It is natural to infer from this that much might be gained by careful study of the dielectric constants of crystals, especially at temperatures immediately below the melting point. Much the same applies to observations of absorption spectra in crystals at different temperatures. A promising start has already been made at the low temperature end, but the technical difficulties are great, and the results will need much skill to interpret.

No attempt has been made to discuss the Raman effect in relation to crystal physics and crystal chemistry: already the literature is voluminous, and the significance of some of the results by no means clear. The method is certainly of great value. Statistical mechanics may be expected to play a considerable part in the future development of the new crystallography; in fact, all the resources of modern science can contribute something to our knowledge of the solid state.

The First Sugar of Photosynthesis and the Rôle of Cane Sugar in the Plant

PHOTOSYNTHESIS, upon which all living organisms depend directly or indirectly for their existence, is still imperfectly understood We know that the green plant takes in its carbon in the form of the carbon dioxide of the air, and we also know that carbohydrate appears in the leaf, as the result of the fixation of the carbon through the action of the sun's rays with the chlorophyll The intermediate stages are still a matter of conjecture

The formaldehyde hypothesis of Baeyer put forward so long ago as 1870 still awaits clear proof Supposed conclusive evidence in its support has from time to time been advanced , but on critical examination has proved unacceptable This has happened in a recent attempt to establish the validity of the theory Klein and Werner [1] using the delicate test of dimedon for aldehyde were in a measure convincing Barton-Wright and Pratt,[2] however, in repeating and checking their work, now show that the formaldehyde detected in the experiments is due to the action of light on carbon dioxide and bicarbonates, and is independent of the photosynthetic mechanism of the living plant They sum up the matter thus "Although the formaldehyde hypothesis has the merit of simplicity, which has probably been the prime cause of its wide popularity, no work has as yet convincingly shown that formaldehyde is produced normally in the green leaf or that it plays any part in the photosynthetic process of the living plant"

This statement is perhaps a little too sweeping As formaldehyde is toxic to the plant, it is scarcely to be expected that it should accumulate in the free state in an appreciable amount under normal conditions It may be assumed that, as soon as the reduction of the carbonic acid takes place, the aldehyde formed is at once polymerised to sugar

The important work of Baly on photosynthesis *in vitro* is here relevant He has shown recently [3] that when a solution of carbon dioxide is exposed to ultra violet light, formaldehyde is first formed and then sugar But when a coloured catalyst, such as cobalt or nickel carbonate, is present, the action takes place in ordinary light with the direct production of sugar, no aldehyde being detected Something analogous may therefore take place in the green leaf The magnesium of the chlorophyll may be the active metal concerned Hence on such a supposition it will be futile to search for free aldehyde in assimilating leaves

In respect of the generally accepted view that some form of carbohydrate is the final product of carbon assimilation, the question as to the exact nature of this is still not completely answered The classical experiments of Sachs conducted from 1862 onwards proved conclusively that the starch grains, which appear on the chloroplasts of the leaf when exposed to light, are the direct result of the fixation of carbon Starch thus became known as the first visible product of assimilation It was assumed that sugar, probably glucose, preceded the formation of starch

Brown and Morris were the first to undertake elaborate estimations of the carbohydrates contained in foliage leaves From their investigation of the carbohydrates in the leaf of the garden nasturtium (*Tropæolum majus*),[4] they concluded that cane sugar (sucrose) is the first carbohydrate to be set free in photosynthesis This was an unexpected and novel idea, as sucrose, being a disaccharide, had hitherto been regarded more in the light of a reserve carbohydrate They essayed a formidable task—a pioneer effort to estimate separately in the leaf four sugars (sucrose, maltose, dextrose, and levulose) as well as starch The hydrolytic product of the starch complicated the issue Monocotyledons, as a whole, in contrast to dicotyledons, form little starch in their leaves in normal circumstances, and some none at all In following up Brown and Morris's work, Parkin, in order to simplify the problem, chose one of the latter, namely, the snowdrop [5] He found he had only three carbohydrates with which to deal, namely, sucrose and its two hexose derivatives, dextrose and levulose He interpreted his results likewise in favour of sucrose being the first sugar liberated, and he regarded the two hexoses as arising from it through inversion

The Rothamsted workers, Davis, Daish, and Sawyer, were the next to take up the subject They advanced this side of biochemistry considerably by pointing out weaknesses in former methods and by elaborating new ones of extraction and analysis They investigated in detail the carbohydrates of the mangold and potato leaf,[6] and in their conclusions also support the view that sucrose is the first sugar of photosynthesis

Now the pendulum is swinging the other way Two important papers, by Clements [7] and by Barton Wright and Pratt,[8] published last year, both favour the view that glucose (dextrose) is the first sugar to be liberated—a view, of course, more in harmony with Baeyer's hypothesis and also with chemistry generally These investigators have carried out estimations at hourly intervals during both day and night—an advance upon what has been previously attempted

Clements, an American worker, took for his research the leaves of the sunflower, the potato, and *Soja max* Barton-Wright and Pratt, of Great Britain, selected the daffodil, which normally does not produce starch in its leaf Their results are therefore comparable with those of Parkin on the snowdrop In some respects they confirm the latter's work, though as regards the first sugar of photosynthesis they argue cogently for the opposite view

Methods of analysis are naturally of prime importance in work of this kind Each fresh investigator generally manages to bring to light flaws in previous methods The Rothamsted workers with all their care are shown by Barton-Wright and Pratt to have overlooked a point which may have seriously prejudiced their figures for the hexose sugars They find that the alcoholic

extraction method used by Davis, Daish, and Sawyer results in the formation of appreciable amounts of aldehyde, and this affects considerably both the cupric reduction and the optical rotation

Such work as has been quoted sheds no light on the exact position of the various sugars in the leaf Strakosch some years ago applied certain micro-chemical tests to the assimilating leaf, and found hexose as the only sugar present in the palisade cells, but the reliability of his method is open to question The work of Weevers on variegated leaves, published in 1924, is probably of greater value in support of the glucose view He found both hexose sugars and sucrose in the green parts, but only sucrose in the white portions of the leaf

The balance of evidence at the present time would seem to be in favour of the original supposition that glucose is the first sugar to be set free in photosynthesis On the alternative view, the two hexose sugars are easily accounted for as the inversion products of the sucrose But on the assumption that glucose appears first, then one has to imagine that part of it is first changed to fructose (levulose), and that from these two hexoses sucrose is synthesised If these transformations do take place in the leaf, we are at present quite ignorant as to the means by which they are brought about

Whatever may be the carbohydrate sequence in photosynthesis, there is cumulative evidence pointing to cane sugar as of wide, if not of universal, distribution among the higher plants Apparently it is of fundamental importance, since no matter what form the carbohydrate may take in the seed or reserve organ, sucrose soon makes its appearance on germination The evidence is increasing that carbohydrate can travel largely in this form Mason and Maskell's important work on the cotton plant [9] favours this Then, again, as a rule, leaves when fed with sugar solutions form starch more readily from sucrose than from any other sugar Notwithstanding this apparent desire of the plant to have its carbohydrate in the form of sucrose for circulatory and metabolic purposes, there is no important reserve carbohydrate which yields cane sugar directly by enzymatic action [1]

In view of the fact that starch, the commonest of reserve carbohydrates, yields maltose when acted upon by its enzyme, diastase, this disaccharide rather than sucrose might have been expected to be chiefly evident in plant tissues, but it is not so It may be that a non reducing disaccharide is desired Maltose has reducing properties, but sucrose has not Then it has been suggested that the two hexose sugars, dextrose and levulose, which arise from the sucrose through inversion, may play different rôles in metabolism Further, it is possible that these hexoses are more active when in the nascent state, that is, at the moment of their formation from sucrose through hydrolysis This would account for cane sugar being found in meristematic tissue, upon which Priestley [10] laid stress a few years ago J P

[1] *Biochem Zeit*, 1926
[2] *Biochem Jour*, **24** 1930
[3] *Proc Roy Soc London* 1927 and 1929
[4] *Jour Chem Soc* 1893
[5] *Biochem Jour*, 1911
[6] *Jour Agric Sci* 1916
[7] *Bot Gaz* vol 89
[8] *Biochem Jour* vol 24
[9] *Ann Bot* 1928
[10] *New Phytologist* 1924

Obituary

PROF HUGH RYAN

BY the death on Mar 27 of Prof Hugh Ryan at the age of fifty-eight, Irish chemists have sustained a loss which they will feel for many years to come

Hugh Ryan was educated at Blackrock College, Dublin, and received his earlier chemical training under Prof A Senier in Queen's College, Galway Graduating in 1895, he obtained the M A degree, with gold medal, in 1897, and then proceeded to Berlin, where he engaged in research under Emil Fischer and Siegmund Gabriel Returning to Dublin in 1899, he was appointed professor of chemistry in the Catholic University School of Medicine and in University College, St Stephen's Green, Dublin In the same year he was awarded the D Sc degree and appointed fellow of the Royal University of Ireland On the foundation of the National University of Ireland in 1908, Ryan became professor of chemistry in University College, Dublin, a position which he occupied until his death In 1924 he was appointed Chief State Chemist in the Irish Free State and was responsible for the organisation and control of the State Laboratory

Throughout the entire period of his association with university teaching, Ryan devoted a large part of his time to research and published more than seventy papers In his earlier work, influenced by his period with Fischer, he was engaged on the synthesis of glucosides His researches in this direction, carried out under the most discouraging conditions, display his extraordinary enthusiasm and skill as a chemist With the erection of the new buildings of University College, Dublin, under the Irish Universities Act of 1908, he had, for the first time, adequate laboratory equipment, and his remarkable powers as an organic chemist were given fuller scope There followed a series of researches on the constitution of certain waxes and the preparation of a number of compounds allied in character to the colouring matter of turmeric Further papers dealt with the synthesis of natural organic colouring matters and the preparation of derivatives of diflavone, diflavanone, and dicoumaranone At the request of Nobel's Explosives Company, he undertook investigations on the mode of action of stabilisers in propellent explosives, the results of which were of the greatest value Numerous other papers discussed the condensation of aldehydes with ketones and the structure of catechin Ryan's many activities included a profound interest in Irish peat industries, and on this subject he furnished a very complete report to the Royal Dublin Society

While his main interests lay in the direction of organic chemistry, the extraordinary breadth of Ryan's knowledge of all branches of chemistry always aroused the admiration of his colleagues, both in Great Britain and Ireland. To Irish men of science his great achievement was that he created in Dublin, from small beginnings and almost unaided, an important school of research in chemistry. The range of his influence in this respect, already widely felt, will be more fully appreciated in the future.

In public and private life Hugh Ryan was a most lovable and sterling character, with a rare simplicity and charity of outlook. His untimely death will cause genuine grief among the many students of science, engineering, and medicine who received instruction from him. J. ALGAR.

WE regret to announce the following deaths:

Dr. T. V. Barker, secretary to the University Chest in the University of Oxford, author of numerous books and papers on mineralogy and chemical crystallography, on April 15, aged fifty years.

Prof. E. P. Culverwell, senior fellow and professor of education in Trinity College, Dublin, who was known for his work on the calculus of variations and mathematical and physical theories of the Ice Age, on April 17, aged seventy-five years.

Prof. J. Lorrain Smith, F.R.S., professor of pathology and dean of the faculty of medicine in the University of Edinburgh, on April 18.

The Ven. J. M. Wilson, sometime canon of Worcester and headmaster of Clifton College, who was a member of a British Association committee on science in schools so long ago as 1866, on April 15, aged ninety-four years.

News and Views.

THE preliminary programme has now been issued of the centenary meeting of the British Association, to be held in London on Sept. 23–30, under the presidency of the Right Hon. J. C. Smuts. So far, of course, only the barest outline of the proceedings is possible, but it is clear already that the meeting is going to be worthy of the occasion. The reception room and offices for the meeting will be in the University of London (Imperial Institute Road, South Kensington). General Smuts will assume office at a meeting in the afternoon of Sept. 23 in the Albert Hall, where the Faraday Centenary Exhibition is being held, and will deliver his presidential address on the same evening at the Central Hall, Westminster. Special tickets will be required for General Smuts's address; arrangements are being made for relaying it to other halls if necessary. Evening discourses will be given by Prof. W. A. Bone (photographic analysis of explosion flames), Sir P. Chalmers Mitchell, Sir Arthur Keith, Sir Oliver Lodge (a retrospect of wireless communication), Sir William Hardy, and Sir James Jeans. The Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered on Sept. 29 by Dr. G. Thilenius, and members of the Association are invited. Various public lectures will be given in certain polytechnic institutions in London. It is expected that receptions will be given on Sept. 24 by the Royal Society, in connexion with the Faraday celebrations, and on Sept. 25 by H.M. Government. Exhibits and demonstrations are again being arranged by the British Broadcasting Corporation. London and its neighbourhood will provide plenty of opportunities for sectional excursions. Down House, Darwin's home for many years and now in the care of the Association, is within easy reach, while an invited party will visit York, the birthplace of the Association, on Sept. 26–27. Preceding the meeting will be a geological excursion to East Anglia on Sept. 16–22, and those wishing to take part are requested to communicate with Mr. I. S. Double, University, Liverpool, as soon as possible.

THE formative influence upon the teaching of science in schools which was exerted by Canon J. M. Wilson, whose death has recently occurred, was evident so far back as 1866, when he was a member of a committee with Dean Farrar, Prof. T. H. Huxley, and Prof. J. Tyndall, appointed by the British Association at its meeting at Nottingham, "To consider the best means of promoting scientific education in schools". The report of this committee was issued in 1867 and laid stress on science as an essential subject in the curriculum, not necessarily to train physicists and chemists but as an effective instrument in mental development. The subjects suggested in the report were elementary physics, elementary chemistry, and botany. Canon Wilson, in a paper on "Teaching Natural Science in Schools", published in 1867, gave an account of methods adopted in introducing science teaching in Rugby School. He selected botany as the best subject for beginning to train boys in scientific method. This was followed by experimental physics. By his choice, he seems to have anticipated the present-day position of botany in the school curriculum, at any rate, from the theoretical point of view. There is much discussion on the position of botany, or elementary biology, in the school curriculum, but there is still much to be done in a practical way. There are comparatively few secondary schools, especially for boys, where science is introduced by botany or biology, as it was sixty-five years ago under Canon Wilson at Rugby. The sole idea in Canon Wilson's mind was to train independent observation and reasoning, not to supply the biology 'demanded' by the first examination for medical and dental degrees and diplomas, which some of our public and secondary schools are now doing with not quite satisfactory results.

ON April 28, one hundred years ago, the eminent mathematician and physicist, Peter Guthrie Tait, was born at Dalkeith. Educated at Dalkeith Grammar School and the Edinburgh Academy, in 1847 he entered the University of Edinburgh and the following year became an undergraduate of Peterhouse, Cambridge. At the age of twenty-one, he graduated as Senior Wrangler, being the youngest on record. He was also Smith's prizeman. Two years later he was appointed professor of mathematics in Queen's College, Belfast, having Andrews for one of his

colleagues In Ireland he also made the friendship of Sir William Hamilton, through whom he became the great exponent and advocate of quaternions After four years at Belfast, Tait was chosen to succeed J D Forbes as professor of natural philosophy in the University of Edinburgh, and this post he held with great distinction until the year of his death, which occurred on July 4, 1901 His biographer gives a list of 22 volumes and 365 papers written by him alone or in collaboration with others Most famous of all is the "Treatise on Natural Philosophy", written jointly with Sir William Thomson, afterwards Lord Kelvin, and generally referred to as "T and T[1]" This work, it has been said, takes rank with Newton's "Principia", Laplace's "Mécanique céleste", and Maxwell's "Electricity and Magnetism" Other works included Tait's "Thermodynamics" (1868), "Heat" (1884), "Light" (1884), and "Properties of Matter" (1885) He also translated Helmholtz's "Vortex Motion" and Mohr's "Views on the Nature of Heat"

Two volumes of Tait's scientific papers were published in 1898 and 1910, and his biography by Prof C G Knott appeared in 1911 His portrait was painted three times by Sir George Reid and the pictures are to be seen at Peterhouse, the Royal Society of Edinburgh, and the Scottish National Portrait Gallery respectively As a professor, he was distinguished by his earnest attention to the duties of his chair and by his capacity of inspiring his pupils with both enthusiasm and affection He was as successful in presenting the elemental or fundamental truths of science as he was in advancing its range and attacking new problems A keen golfer and able to apply mathematical analysis to the flight of a golf ball, on one occasion when staying at St Andrews, his guest, Helmholtz, then about fifty years old, wrote "Mr Tait knows of nothing else here but golfing I had to go out with him, my first stroke came off—after that I hit either the ground or the air Tait is a peculiar sort of savage, lives here, as he says, for the muscles, and it was not till to day, Sunday, when he dare not play and did not go to church either, that he could be brought to talk of rational matters" With Balfour Stewart, however, Tait published a book on the "Unseen Universe" which, while it called forth praise and censure, fulfilled the authors' purpose to show that the common statement that "Science is incompatible with religion" was baseless Tait's correspondents included Kelvin, Maxwell, Cayley, Hamilton, and many other scientific men of the Victorian age

THE Paris correspondent of the *Morning Post* states, in the issue of April 10, that news has been received in Russian circles in Paris that Profs Michaelovsky and Saposhnikoff have been arrested and exiled to the far north of Russia The reasons for their arrest and exile are unknown in Paris Prof Saposhnikoff is well known in scientific circles in Great Britain and this news will cause much sorrow to his friends here He was frequently in England and took part in the International Congress of Applied Chemistry held in London in 1909 He also spent considerable time in Great Britain during the War, and for his services at that time he was made a Knight Commander of the Order of St Michael and St George In the early days of the revolution, Prof Saposhnikoff was imprisoned for several months in Petrograd and his two sons were shot After his release he held several important posts and visited the Continent and England on official business for the Soviet Government He was professor at the Michael Ordnance Academy and also at the Institute of Roads and Communications He was a diligent worker and published much work of scientific value

PROF SAPOSHNIKOFF is a pioneer in the chemistry of explosive substances His work on the decomposition of nitrocellulose and his investigations in connexion with the nitrating properties of nitric acid in sulphuric acid with reference to the vapour tension of the mixture were acknowledged as important contributions by all explosives chemists He worked on a variety of other subjects of purely scientific interest and was also the author of a number of papers on metallurgy, including investigations on the microstructure and physical properties of alloys His papers during the period 1903 12 occupy a column in the index of the *Journal of the Chemical Society* The results of his investigations appeared in Russian, German, and French journals, and since the War he has contributed many papers on scientific and technical subjects, which have been published in Russia Prof Saposhnikoff is sixty three years of age and has a record of highly valuable scientific and technical work which is recognised and appreciated by all scientific workers in Europe It is little short of disastrous that the world, as well as Russia, should be deprived of the services of a man who is still capable of doing excellent work for the benefit of humanity

IN our issue of April 18, p 600, we printed a very brief account of the history of the Paris Observatory, prompted by the reports in the daily press that the Observatory was closing down and that a new national observatory was to be built in the Durance region of Provence These reports, it seems, are incorrect and we much regret having given them further currency by repeating them M Ernest Esclangon, Director of the Paris Observatory, has written explaining the present position and prospects of the Observatory, and we cannot do better than reproduce his words "Il n'est nullement question d'abandonner l'Observatoire de Paris, bien au contraire Nous demandons seulement qu'une grande succursale de cet observatoire soit créée en Provence où le ciel est particulièrement beau, cette succursale serait dotée d'instruments puissants et modernes, notamment de grands télescopes L'Observatoire de Paris garderait toute son importance, un grand nombre de services d'observation y seraient conservés, notamment le service méridien, le service de l'heure, le service des équatoriaux pour les observations d'étoiles doubles, le service des observations solaires installé à Meudon, etc En outre, l'Observatoire de Paris centraliserait les

documents que les astronomes iraient recueillir dans la succursale en Provence, étudierait ces documents, en tirerait les conclusions, en un mot, l'Observatoire de Paris, en plus des services d'observation qui y seraient conservés, constituerait comme le cerveau de l'organisation d'ensemble Mais au surplus, tout cela reste pour le moment à l'état de projet, et aucune décision n'a pu être prise puisque les crédits nécessaires pour cette réalisation ne sont pas encore votés, et qu'actuellement, nous ne disposons pas des moyens pécuniaires indispensables pour mettre ce projet à exécution " We welcome this very clear statement by M Esclangon and trust that funds will be quickly forthcoming to enable the realisation of the scheme he has outlined

THE official report on the Hawkes Bay earthquake of Feb 3 has been received from Lord Bledisloe, Governor General of New Zealand The loss of life (212 persons) was due mainly to the fact that the centre of the earthquake—somewhere beneath the Pacific Ocean—was not far distant from two towns, Napier and Hastings, containing between them a population of about 35,000 The shock was felt over a great part of the North Island and the northern district of the South Island, while the area over which material damage occurred extends from near Gisborne on the north to Waipawa on the south, and from Tarawera on the west to the Pacific Ocean The houses that generally withstood the shock were those of wood or reinforced concrete Brief but interesting accounts of the Murchison earthquake of June 17 1929, are contained in the Report of the Dominion Astronomer and Seismologist for the year 1929 and in an article on the "Seismology of New Zealand", published in the *New Zealand Official Year book* for 1931 The map of the isoseismal lines shows that, except for very small areas in the extreme north and south, the earthquake was felt throughout both islands The movement along a fault near Murchison raised the ground on the east side about fifteen feet and shifted it about nine feet to the north west Recent levellings show that the block is now sinking back somewhat irregularly, a movement that is no doubt responsible for the after shocks felt so frequently in the central area Of these, no fewer than 632 were recorded by the end of the year at the Wellington Observatory

THE annual exhibition of the Television Society was held on April 15 at University College, London The number of exhibits was greater than in previous years The trend of development is in the direction of large screens with projection methods suitable for large audiences The Tuke cup was awarded to R Wilson and A A Waters for an excellent television equipment with a mirror drum receiver and screen projector In this system the person being televised is not dazzled by excessive light, and he can be seen at the same time as the image on the screen It worked very satisfactorily, and the receiving set is small and quite ornamental, which we consider a great step in advance In television between places about a hundred miles apart, 'echo images' are sometimes observed, one image being partly superposed on the other T H Bridgewater showed how this phenomenon can be used to determine the height of the Kennelly-Heaviside layer The research laboratories of the General Electric Co showed two gas discharge tubes which operate directly from the 200 volt alternating current mains without using high tension transformers The sodium tube gives a yellowish light and the neon mercury vapour in a uranium glass tube gives a bluish white light We were impressed by the educational exhibits Printer's blocks were prepared showing the amount of definition possible by different television scanning systems, and simple diagrams illustrated the underlying principles of television The G P O exhibited excellent photographs received in Great Britain from Austria, Denmark, Germany, and Sweden by the Siemens Karolus Telefunken system The British Stenode Radiostat Corporation showed various stenode models of radio receivers of very high selectivity

As there is little more than one per cent of the world's main line railways electrified, there is plenty of scope for electrical engineers to convince the railway companies of the advantages of electrification There is general agreement that suburban and tube railways should be electrified Where the trains are continually starting and stopping, electrification enables the lines to carry far more passengers and to accelerate the service In underground tunnels and in tube railways, the noxious vapours generated by steam trains makes electrification compulsory After the War the Austrian Government obtained an international loan, a part of which it set aside for main line electrification In 1927, however, the work was stopped and the money used for other purposes Large portions of the scheme were therefore left unfinished One of the reasons was the lowering of the price of imported coal, and another was possibly that too favourable a view had been taken of the costs of electrification In *World Power* for March, Dr M G Say discusses these aspects of railway electrification Main line electrification is not favoured in Great Britain because coal is cheap, the gradients are seldom severe, and there are scarcely any main lines where the tunnels render steam haulage hazardous The London Brighton line, 51 miles in length, will be the longest electrified route in Great Britain It will be worked by multiple unit trains of six coaches The present steam train service of two million train miles per annum will be replaced by an electric service of nearly five million train miles The conversion cost is estimated at about £50 000 per mile, and energy outside the London area will be obtained directly from the national grid network The maximum speed of 65 m p h will enable the quickest trains to have an average speed of 54 m p h If this line is successful, it will probably be the forerunner of further electrified zones eastwards and westwards from Brighton and Worthing

THE first and the most useful of the commercial applications of radio communication was to marine navigation In his chairman's address to the wireless section of the Institution of Electrical Engineers,

published in the March number of the *Journal* of the I E E, C. E Rickard gives interesting data of the progress that has been made The international legislators who frame the rules and regulations for wireless communication insist that marine radio telegraphy shall progressively improve and, so far as economically possible, keep in step with modern progress About fourteen thousand of the world's ships are now fitted with wireless apparatus Of these, about ten per cent are fitted with valve transmitters and the rest with spark only Spark transmitters of 100 watts input power are generally considered to provide the best form of emergency apparatus, probably because it is thought that a strident and hoarse cry for help will attract the most attention By the new international regulations, no spark transmitters of greater power than 300 watts input power are to be installed From now onwards, therefore, the percentage of high power spark stations on board ship will steadily decrease There are about twelve thousand ships fitted with automatic alarm devices which enable a ship's operator to be called to his post when he is not on watch At the end of last year, about five hundred ship's lifeboats were fitted with wireless Vessels of less than 1600 tons gross tonnage which do not carry passengers are under no legal obligation to have radio apparatus Many of them, however, are fitted with radio, as it is found of great value not only in navigating the ship but also in carrying on their business In particular, trawlers, whalers, and other vessels connected with the fishing industry are generally equipped with radio There are now more than 200 automatic radio beacons around the coasts of the leading maritime countries of the world

THE new Welland Ship Canal between Lakes Erie and Ontario, which was opened on July 1, 1930 (NATURE, July 5, 1930, p 30), allows vessels of ocean liner size to pass round Niagara Falls and removes one of the two great barriers that have kept deep sea shipping out of the Great Lakes Between the lakes and the ocean only the barrier of the Lachine Rapids, round which smaller vessels alone can pass, remains But the largest lake vessels, about 600 feet in length, are now able to get into Lake Ontario There are 21 electric drawbridges over the new canal, some of them spanning the canal's full width of 320 feet Unlike the Panama Canal, where only the locks are illuminated, the entire length of the canal is lighted like a city street The Welland locks are tremendously deep Three of them give a total lift of 140 feet in less than three quarters of a mile The electrical equipment is built by the Canadian Westinghouse Co, Ltd The locks have corridors, steps, and electrically lighted mooring platforms, half way down the sides The attendants check the way of the ship as it sails in at the lower level As the water comes in, the men retreat and the lock is flooded The electric lamps in their water tight globes are left burning far underneath the water One end of the canal is 326 feet higher than the other If it were not for the lock-gates, Lake Erie would run into Lake Ontario, forming a new Niagara Falls In the unlikely event of a lock-gate failing, there is a boat with powerful hoisting gear always ready to plug the canal by an emergency gate

A CONFERENCE of teachers and other professional experts in prehistoric archæology will be held in Bern in May, at the personal invitation of Prof Bosch-Gimpera, of Barcelona, to discuss the future organisation of prehistoric studies This conference arises out of suggestions which were discussed at the Congress of Archæology held at Barcelona in 1929, when the question was raised whether, in view of the situation which had arisen in regard to international congresses in archæology, it was desirable that the prehistoric section of the Congress of Archæology should be enlarged It then appeared that there was a desire for a quite new organisation Since 1929, however, there has been a fundamental change in the situation The attempt made by the Institut international d'Anthropologie of Paris to revive, and at the same time absorb into its own machinery, the old pre-War Congrès d'Anthropologie et Archéologie préhistorique, by issuing a joint invitation to the congress at Lisbon in 1930, would appear to have strengthened the dissatisfaction of archæologists with the present position rather than have reconciled them to a congress which, while international in name, is attached to a permanent organisation, bound under French law to be predominantly French in composition As a result of inquiry, it would appear from a report published by Prof J Myres in the April issue of *Man*, there is a widespread agreement among archæologists of all nationalities, including even some French, that future congresses should be entirely separated from the Paris Institut and, in fact, that the old Congrès should be revived in accordance with its former statutes

PROF MYRES goes on to forecast the probable lines of discussion at Bern in the light of consultations and correspondence with Continental archæologists The questions to be settled will be whether international organisation in the future should provide for a single congress to cover all human sciences, anthropology, ethnology, technology, as well as prehistoric archæology, or should (at any rate at present) a congress be organised to deal with prehistoric archæology only, and, secondly, whether an entirely new congress on fresh principles should be organised, or should the pre War Congrès d'Anthropologie et Archéologie préhistorique be revived by friendly agreement with the surviving representatives of the old Congres and the Paris Institut as an entirely independent institution On these points the attitude of British archæologists is set out in a series of resolutions passed at a recent meeting of the Joint Committee on Teaching and Research of the Royal Anthropological Institute a fully representative body In these, the desire is expressed that the Congrès should remain in being as an independent body, and the Committee conveys to the meeting at Bern the hope that any future congress for prehistoric archæology will admit the more general studies of anthropology and ethnology, which illustrate all the various aspects of prehistoric archæology

UNDER the auspices of the Museums Association and the Carnegie United Kingdom Trust, an exhibition of

museum specimens specially prepared for circulation to rural areas was held in the County Hall, Westminster, on Jan 28–30 The exhibition aimed at showing, for the information of museum curators, educationists, and the public generally, what can be done and what is being done to extend the influence of museums to country schools and to the people Nine provincial museums, the Canadian Commission, and three United States museums sent exhibits, which represented very fairly the possibilities of this branch of service, as well as the limitations imposed upon it by difficulties of size and transportability It is very gratifying to know how greatly this museum work is appreciated in the districts where it prevails The *Museums Journal* for March associates with an account of the exhibition, photographs of some of the series shown One of the great difficulties of curators is to obtain, at reasonable cost, cases at once suitable for exhibiting specimens (often of considerable depth) and for bearing the strains of travel by rail or carrier May we suggest that the Museums Association would play a most useful part were it to arrange for the mass production of a standard transportable case, probably after the type used by the American Museum of Natural History, which, to us, seems best to meet requirements

A list of the industrial research laboratories of the United States of America has recently been published as *Bulletin* No 81 of the National Research Council (Publication Office, National Research Council, Washington, D C No price) It is the fourth edition of this bulletin and shows a great increase, in the number of industrial research centres listed, on the third edition of 1927 The increase in number is about 60 per cent and may be indicative of either the great progress of industrial research in the United States or a greater interest of such research laboratories in this compilation by returning data for publication, or both The list is of industrial laboratories only and does not include, therefore, laboratories connected with the Federal, State, or municipal governments, or with educational institutions Since, as the compilers of this bulletin admit, such laboratories often do attack problems of industrial importance, it seems a pity that they were not included These laboratories usually are listed in other publications, yet their inclusion probably would have added to the value of this bulletin, by making it even more comprehensive The data given under each laboratory were furnished by the director of the laboratory, in reply to a questionnaire, of which the chief parts apparently were name and address of the company (under which the laboratory is listed), director and research staff, account of research work, and, in a few cases, development work Following this list of industrial companies' laboratories, is an alphabetical list of directors and their addresses Then comes the geographical distribution of the laboratories, grouped into towns and States Finally, there is an alphabetical grouping of the subject matter of research The last two lists form indexes to the whole volume, thus making reference comparatively easy So far as we know, there is no similar list of industrial research laboratories in Great Britain, such a list should prove of great value as a reference guide to all types of research workers

It is announced that the Whipsnade Zoological Park will be opened to the public on Saturday May 23 The park will be open every day afterwards, including Sundays from 10 A M until lighting up time

A small earthquake was recorded at Kew Observatory at 17 hr 3 min 9 sec G M T on April 15 It is estimated that the disturbance originated 1300 miles away, the epicentre being under the Atlantic to the north of the Azores

The Faraday Medal (tenth award) will be presented to Mr Charles H Merz at the ordinary meeting of the Institution of Electrical Engineers to be held on Thursday, April 30 The presentation will precede the twenty second Kelvin Lecture, which will be delivered by Prof W L Bragg on "The Architecture of Solids"

The annual visit to the Research Station, Long Ashton, Bristol, will take place on May 7, when the ciders made during the season 1930–31 will be displayed and the fruit plantations of the Station will be open to visitors from 11 A M to 4 P M Demonstrations of small horticultural machines and implements, including cultivators, spraying and dusting machines, etc, will be in progress throughout the day

The Pontifical Academy of Sciences (Nuovi Lincei) is offering a prize of 10,000 lire for a critical dissertation on the law of Mendel and the chromosome theory Essays must be unpublished and may be written in English, French, German, Spanish, Italian, or Latin They may be signed or written under a pseudonym, and must reach the Pontifical Academy of Sciences, The Vatican City, before Oct 30 The award will be announced at the first meeting of the Academy in December

The work of the National Physical Laboratory is illustrated by a series of transparencies now on view in the entrance hall of the Science Museum, South Kensington They include illustrations of a radium safe, one million volt spark, internal view of the high voltage laboratory, and the primary standard barometer There is also an exhibition illustrating the occurrence of earthquakes and instruments used in their measurement, with the records obtained at Kew from a number of recent earthquakes Both series of exhibits will be on view until the end of June

The Linnean Medal for 1931 of the Linnean Society of London has been awarded to Prof Karl E von Goebel, professor of botany in the University and Director of the Botanical Gardens, Munich The following have been proposed as foreign members of the Society Prof Carl Christiansen, of Copenhagen, Dr K E Correns, Director of the Kaiser Wilhelm Institute of Biology, Berlin, Dr L Diels, Director of the Botanical Gardens, Berlin, and Prof F A F C Went, professor of general botany in the University of Utrecht

Sir James Jeans left England on April 18 for the United States, primarily to receive the Franklin Medal

from the Franklin Institute, Philadelphia On May 18 Sir James will deliver a lecture in Washington under the auspices of the Carnegie Institution He will visit the Bartol laboratories in Philadelphia on May 19, and on May 20 will receive the Medal from the Franklin Institute and there deliver his lecture This will be followed by three lectures, at Princeton (May 23), Harvard (May 25 or 26), and Yale (May 26 or 27), which are being given under the auspices of the Franklin Institute Sir James will sail for England towards the end of May

THE preliminary programme of the forty second congress of the Royal Sanitary Institute, which will take place at Glasgow on July 4 11, has recently been issued Sir Henry Mechan will preside over the congress, which will be divided into the following sections preventive medicine, architecture and engineering, maternity, child welfare, and school hygiene, hygiene of food, hygiene in industry, veterinary hygiene and national health insurance Five conferences have also been arranged, of sanitary authorities, medical officers of health, engineers and surveyors, sanitary inspectors, and health visitors The inaugural address will be given by Sir Henry Mechan, and the congress will terminate with a lecture by Major Walter Elliot on "A Continuous Health Policy" A health exhibition in connexion with the congress is projected, and there will be opportunities for visits to hospitals and other institutions and places of local interest

THE preliminary programme of the Second International Congress of the History of Science and Technology is now being sent out, and we note that it is intended as the subject matter of the Congress is so extensive, that members should speak to three general themes namely (1) The sciences as an integral part of general historical study, (2) Historical and contemporary inter relationship of the physical and biological sciences, (3) Inter dependence of pure and applied science For the afternoons and evenings, visits have been arranged among other places, to the Royal Society, Royal Institution, Royal Observatory (Greenwich), National Museums, Institute of Historical Research and Down House Kent There will also be excursions to Oxford and Cambridge Most satisfactory responses have already been made and the Congress bids fair to be a very great success Further particulars will be furnished upon request by the honorary secretary of the Congress, The Science Museum, South Kensington, S W 7

WITH reference to the article on medals awarded for scientific achievement, published as a supplement to NATURE of Nov 15, 1930, and the additional list in NATURE of Mar 7, our attention has been directed to a further medal award In 1928 the Bombay Branch of the Royal Asiatic Society established a silver medal, to be given triennially to a member considered to have made the most signal contribution in Oriental scholarship during the previous three years The first medal will be presented this year to Mr S V Karandikar, for his book "Hindu Exogamy A Systematic Study of Hindu Marriage Outside the Gotra" This book was noticed in NATURE of Mar 15, 1930

WITH the December number, 1930, the *Tropical Veterinary Bulletin* ceased publication, and in its place the Imperial Bureau of Animal Health is publishing a new journal under the title of the *Veterinary Bulletin* This includes the matter of the *Tropical Veterinary Bulletin* and, in addition, the diseases of temperate climates The first volume of about 384 pages is being issued in four quarterly parts, commencing April 1 but from January 1932 the journal will be published monthly, and the volume will run to about 600 pages The subscription price is £1, post free which should be sent to the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, England

A USEFUL classified catalogue of new and second-hand books on medical subjects has just been issued by Messrs W and G Foyle, Ltd, 119 Charing Cross Road, W C 2 It can be had free of charge upon application

WE have received a volume of collected reprints of "Researches published from the Wards and Laboratories of the London Hospital during 1930" It is edited by Mr Hugh Cairns, and contains 39 papers dealing with a variety of subjects—clinical medicine and surgery radiology, pathology bacteriology, and physiology Five papers deal with psittacosis or parrot fever The paper by Bedson and Western shows that the virus is a filterable one, though probably of relatively large size and that the guinea pig is susceptible to the virus and may be employed for maintaining strains

A CATALOGUE (No 456) of nearly 1300 second hand books of science has just been received from Messrs Bowes and Bowes, 1 Trinity Street, Cambridge The subjects are arranged under the headings of journals (general) agriculture anthropology and ethnology, biography and travel, biology (with microscopy, evolution, and heredity), botany (with a small collection of herbals) chemistry and physics, entomology (with arachnida, and crustacea) forestry and gardening, mineralogy and geology mollusca, ornithology, zoology (general with parasitology), and addenda (all subjects) The prices asked appear very reasonable

APPLICATIONS are invited for the following appointments, on or before the dates mentioned A head of the senior engineering department of the Hull Municipal Technical College—The Director of Education, Education Offices Guildhall, Hull (May 2) A senior lecturer in electrical engineering and an assistant lecturer in marine engineering at the Liverpool Central Municipal Technical School The Director of Education, Education Office, 14 Sir Thomas Street, Liverpool (May 2) A lecturer in mathematics with subsidiary physics and a lecturer in building technology and science at the Rugby College of Technology and Arts—The Principal

and Organiser of Further Education in Rugby, 61 Clifton Road, Rugby (May 8) An assistant in the chemistry department of the Coventry Municipal Technical College- The Director of Education, Council House Coventry (May 22) A professor of anatomy in the University of Birmingham—The Secretary, The University, Birmingham (May 30) A university student in physiology in the University of London- The Academic Registrar, University of London, South Kensington, S W 7 (May 31) A temporary lecturer in chemistry at the Huguenot University College, Wellington, Cape of Good Hope— Miss M S H Kilroe, St Paul's Girls' School, Brook Green W 6

Our Astronomical Column

Comets —*Pop Astr* for April contains photographs of comet Schwassmann Wachmann before and after the recent outburst reported in NATURE for April 11 They were taken by Prof G van Biesbroeck with the 24 inch reflector at Yerkes Observatory The first was taken on Dec 16 1930 when the comet's magnitude was about 16 in spite of its faintness Dr F E Ross has managed to bring out an appreciable amount of coma by making successive photographic copies The second photograph taken on Feb 11 1931, shows the comet as a small bright disc of magnitude 12 5 Examination of the original negative showed a little diffused light at the edge of the disc, but the extended coma had vanished By Mar 10 the comet had again sunk to magnitude 16 and the outer coma was again visible On Feb 11 the comet was 7 05 units from the sun 6 33 from the earth Prof van Biesbroeck is confident that it will remain visible round the whole of its orbit which will be a new cometary record It is now within two years of aphelion passage

Dr K Reinmuth of Konigstuhl Observatory, announces in *Astr Nach* 5779 that he has detected images of a comet on plates taken in March 1902 It was 1 5 in diameter with a faint nucleus and a short tail in P A 220 , magnitude 12 0 He suspects that it may be a periodic comet but it has not been identified with any known one The positions are given in the hope that other images may be found on old plates

	G M T 1902	R A 1902 0	N Decl 1902 0
Mar	4ᵈ 10ʰ 19 9ᵐ	11ʰ 4ᵐ 37 03ˢ	1 13′ 34 3″
„	5 9 38 3	11 4 13 62	1 15 23 5
	5 10 22 2	11 4 13 12	1 15 27 7
„	5 11 5 8	11 4 12 32	1 15 32 5

Another Interesting Schwassmann - Wachmann Object These two astronomers of Bergedorf Observatory are the joint discoverers of several interesting comets The latest of their discoveries is probably a minor planet it attracted considerable attention from its rapid retrograde motion of $-1^m\ 42^s$ daily and its highly inclined orbit *Circ* 413 of Astron Rech Instit contains the following preliminary orbit, computed by Dr A Kahrstedt

Epoch 1931 March 24 0 U T

M	19 6013	
ω	134 2787	1931 0
Ω	0 0056	
i	33 1919	
φ	21 4017	
Period	5 524 years	
log *q*	0 2977	

The aphelion is about a unit inside the orbit of Jupiter, so the perturbations will be considerable The magnitude is 13

Parallaxes of Stars at different Galactic Latitudes —*Publication* No 45 of the Groningen Laboratory has a paper on this subject by Dr P J van Rhijn and B J Bok Its object is a re determination of the mean secular parallaxes of stars of various magnitudes grouped with reference to their galactic latitudes It is concluded that the distances of the faint stars in high galactic latitudes were over estimated in the similar research in *Publication* No 29 The proper motions have been re investigated, using all the recently published star catalogues and some special investigations for faint stars by Alden, P van de Kamp, and A van Maanen The effects of galactic rotation have been taken into account, using Oort's formulæ of correction

The following is a summary of the resulting mean secular parallaxes

Mag	Lat 0 to 40	Lat 40 to 90
7 0	0 033″	0 047″
9 0	0 017″	0 027″
11 0	0 0086″	0 015″
13 0	0 0045″	0 009″

Tables are given to facilitate the deduction of absolute proper motions of faint stars from their relative values as derived from photographs They include the effect of differential galactic rotation

The Distant Faint Companion of Castor *Bull Astr Inst Netherlands* 6, No 216, contains a full study of this faint star which belongs to the system of Castor, and is, like the two bright components, a close binary , it is also an eclipsing variable The two stars composing it appear to be practically identical in size and brightness, each of them is 432,000 km in radius, and of mass 0 593 sun, density 2 468 sun surface brightness 3 45 magnitudes darker than the sun, total brightness 4 48 magnitudes fainter than the sun Adopting 5741° as the sun's effective temperature, that of Castor *C* is found to be 3400°, in good agreement with its type of spectrum, which is *M* Its colour index is 1 52 magnitude The orbit appears to be circular , the full period of revolution (that is, double the period of light variation) is 0 8142822 day, and the radius of the relative orbit 2 701 000 km The absolute visual magnitude of each component is 9 15 magnitudes It is noted that the masses and magnitudes accord well with Eddington's mass luminosity relation

The Distances of the Cepheid Variables —A recent note in this column described B P Gerasimovic's researches on this subject leading to the conclusion that Prof Shapley's absolute magnitudes needed to be corrected by +1 0 mag , and his distances reduced in the ratio 0 631 to 1 *Astr Nach* 5775 contains a research on the same subject by A Kipper It makes use, in addition to proper motions and radial velocities, of the fact that the angular radius of a star of known colour index can be deduced from its apparent magnitude By applying this to different stages of the Cepheid variation, the change of angular radius can be correlated with the radial velocity. From a combination of all the methods he finds +1 1 as the correction to Shapley's absolute magnitudes This is so close to the 1 0 of Gerasimovic that it gives ground for receiving both results with some confidence

Research Items

A Neolithic Statuette from Malta.—Sir T. Zammit figures and describes in the *Bulletin* of the Malta Museum, vol. 1, No. 2, a fragment of a stone statuette found in 1929 in clearing the exterior of the apses of the Tarxien neolithic temples. What is left of the statuette shows details lacking in other statuettes from the megalithic ruins. It is 30 cm. high and has a width of 21 cm. with a flat base 10 cm. by 7.5 cm. The upper part, corresponding to the waist, has a hollow, carefully worked, which served as a mortice for the insertion of a dowel to bear the upper portion. The figure is draped with a flounced short skirt, and is sitting or leaning on a bench. A pear-shaped leg protrudes beyond the skirt. Each pair of pleats of the skirt is surmounted by a semicircular embroidered line forming a continuous decoration. The hips are prominent. The bench on which the figure sits ends in a horizontal frame supported by standing human figures in high relief, the heads appearing as decorative knobs under the frame. They stand in typical hieratic attitude with the left forearm bent across the breast, the right arm hanging loosely by the side. The figures wear a plain tunic falling in folds to the ankles to conceal the feet. Another figure in bolder relief is seated at right angles to the three figures, its arms folded and its hands resting on the obese thighs. These carved figures are peculiar to Malta.

A New Species of *Ornithobilharzia*.—R. Wetzel (*Proc. U.S. Nat. Mus.*, vol. 78, art. 3, 1930) describes a new species of the trematode genus *Ornithobilharzia* from a Canadian goose from Virginia. The description is based on three males and three females found in branches of the portal and mesenteric veins. The testes in the male are 28 in number, that is, fewer than in other species, and the females are longer than the males (about 9 mm. and 6 mm. respectively). Eggs collected from the intestinal contents of the goose are oval, provided with a small terminal spine, and contain active miracidia. The author gives a detailed description of the anatomical characters of the male and female, and a key to the known species of the genus *Ornithobilharzia*.

Researches on Earthworms.—In vol. 5, No. 3, of the *Science Reports* of Tohoku Imperial University, 1930, there are several papers dealing with researches on various oligochætes of Japan. Some of these worms are very large and lend themselves readily to experiment. *Pheretima* is a favourite genus for the purpose. In the first paper, "On the Body Temperature of the Earthworm", by Hojik Kim, *Pheretima megascolidioides* is used, the purpose of the work being to determine the ability of the adjustment of body temperature within a wide temperature range. These worms quickly adjust themselves to the surrounding medium within the temperature range of from 6° to 23° C., beyond which the ability to regulate steadily decreases as the temperature rises. Three species of *Pheretima* and one of *Allolobophora* were used by Du Hyen Zyeng for his work on the "Distribution of the Intermuscular Nerve Cells in the Earthworm". It is suggested that these cells are vestiges of the primitive nerve net of lower invertebrates. Ekitaro Nomura and Shinryo Ohfuchi continue their work on "The Effect of Inorganic Salts on Photic Orientation in *Allolobophora fœtida*. 5, Sodium Salts—Na_2SO_4, $NaNO_3$ and $NaCl$", and Shinkishi Hatai describes a large new semi-aquatic oligochæte which he names *Drawida hattamimizu*. This is said to have been known for years to the people living in the villages near Kahoku Lake, opening into the Japanese Sea, and is used extensively by the local fishermen as a live bait for eel fishing, the specific name being their local name for it. The largest seen measured more than three feet in length when crawling, although the posterior part was not fully extended. It is an interesting fact that this huge worm made its appearance suddenly in the locality mentioned, and Dr. Hatai thinks it was probably imported—perhaps by the celebrated merchant and explorer Gohei Zeniya, who was born in Hatta village, where the worm is specially abundant. So far it has not been found in other localities, although it is suggested that its original home is very likely to be in the Philippine Islands or in Java, which Gohei Zeniya is supposed to have visited in his travels. Minoru Oishi, "On the Reproductive Process of the Earthworm *Pheretima communissima* (Goto et Hatai), Part 1", records some very interesting observations on the mating of these worms.

Lipin of *Hevea* Latex.—E. Rhodes and R. C. Bishop (*Quarterly Journal of the Rubber Research Institute of Malaya*, vol. 2, No. 3, 125-135) have isolated from fresh latex a complex lipin-like substance which exists in the latex in quantities of the order of 0.2 per cent. It was obtained as a solid waxy body by laborious treatment of fresh samples of the latex with rectified spirit, concentration under reduced pressure, and subsequent ether extraction. The substance disperses in water, reduces the water-air surface tension, and the very stable aqueous suspension is coagulated by acids at pH 1.9 to 2. The method of preparation, general chemical properties, and the products obtained by hydrolysis clearly indicate that the substance obtained was a lipin but of quite complex and not entirely elucidated structure. Different samples have constant N : P ratio (1 : 1.31) and 95 per cent of the fatty acids, which constitute 70 per cent of the total weight of the substance, are liquid and have iodine number 123. Like some other similar bodies from plants, it contains a large amount of carbohydrate (10 per cent) which was only removed by somewhat drastic hydrolysis. Apparently the sugar is not present as reducing sugar, though reducing properties are quite evident after acid hydrolysis, when an osazone may be prepared. Though the presence of glycerol has not been definitely established nor the particular nitrogen base or bases identified, it is interesting to note that calculations of the phosphorus as glycerophosphoric acid, the nitrogen as choline, the sugar as hexose, together with the fatty acids, unsaponifiable material and ash, enable a complete account to be made of the original material. This lipin complex has also a technological claim to examination since Messrs. B. J. Eaton, E. Rhodes, and R. C. Bishop (*ibid.*, pp. 136-138) have shown that it has an accelerating effect on the rate of vulcanisation.

Embryology of *Sargassum*.—Until recently, comparatively little has been known of the details of embryology of the Fucales apart from a few of the northern hemisphere genera, such as *Fucus* and *Pelvetia*. The studies on a number of sub-tropical genera and species by the Japanese school of botanists should help towards a more definite classification within the group and especially in the sub-group of the Cystosiro-Sargasseæ, which is well represented on that coast. Inoh's paper on "Embryological Studies in Sargassum" (*Science Reports* of the Tôhoku Imperial University, vol. 5, No. 3) shows that the species examined—12 out of the 41 in Yendo's monograph—fall into three groups, each of which is characterised by the method of segmentation of the primary rhizoid cell and the number of rhizoids produced on the embryo. At first sight, this appears a somewhat detailed point on which to base a comparison

of species, but so far as it has been investigated, the embryology, which is also associated with the size of the egg, appears to be very constant and also to be associated with definite features of the subsequent habit of the plant If further investigation confirms the constancy of certain types of embryo development, this should prove to be a useful method in deciding affinities of doubtful species A case in point is that of *Turbinaria* (?) *fusiformis*, which some algologists have suggested should be placed under *Sargassum* This suggestion receives support from embryology, as the details described by Tahara for the segmentation of the rhizoidal cell and number of rhizoids agree with the details given by Inoh for a group of *Sargassum* species which are characterised by the irregular division of the primary rhizoidal cell into eight cells, each of which grows out into a rhizoid

Sugar Beet Varieties —Among the reports published in vol 2, No 4, of the *Journal* of the National Institute of Agricultural Botany, that which deals with the sugar beet variety trials during 1927-29 is of particular topical interest The tests have been carried out with replicated plots at several centres simultaneously and have been repeated successively, all results receiving statistical treatment The types of sugar beet fall into three main groups (1) class *E*, which is high yielding, but with average or less than average sugar content, (2) class *Z*, with a high sugar content, but with yield below the average, (3) class *N*, which consists of varieties intermediate between *E* and *Z* The report deals with strains of the *E* type, Dippe *E* being selected as a standard for comparison From the point of view of yield, Kleinwanzleben *E* proved the best variety, Dippe *E* and Hoerning *H S* taking the second and third places respectively As regards sugar content, however, these three strains were poorer than any other, yet on a basis of yield of sugar per acre, they again headed the list Further, Kleinwanzleben *E* and Dippe *E* proved the most profitable when their cash value per acre was determined, a figure calculated from yield sugar content, and factory price In estimating the value of sugar beet crops the yield of tops must not be overlooked, but on this point also these varieties proved satisfactory As regards non bolting tendencies however, Kleinwanzleben *E* was slightly the superior For general purposes therefore, Kleinwanzleben *E* and Dippe *E* are recommended as the most suitable for growing under English conditions, but on rich black soils, Marsters or Kuhn *P*, both small topped and non bolting strains, are considered preferable, for the danger of excessive leaf development is avoided, and they may be sown very early with safety

The Proposed Madden Reservoir (Panama Canal) —The necessity of a large supply of water for lockages in the Panama Canal has engaged the attention of the engineers in charge for many years In recent years it has become increasingly evident that more water than is now available in Gatun Lake during the dry season must be provided to meet future requirements Consequently studies have been made of the feasibility of a storage reservoir on the upper Rio Chagres which would conserve the flood waters for use in the dry season, allow the development of additional hydro electric power, and aid in the prevention of dangerous currents such as occur in the Canal near Gamboa during floods The geological investigation has been made by F Reeves and C P Ross, and their conclusions and recommendations are published in *Bull* 821 B of the U S Geol Surv, 1931 (pp 49 and maps) The rocks are calcareous and tuffaceous sedimentary rocks of Tertiary age, resting on a volcanic complex of probable Eocene age They are bent into a structural basin that corresponds approximately with the topographic depression in which the reservoir would be formed The structure is such as to assure that any leakage would find its way into Gatun Lake, as desired Some of the rocks are thus permeable to water and others are mechanically weak, but despite these disadvantages the project is found to be feasible

Glacial Geology of Connecticut —Prof R F Flint, of Yale, has recently completed the first systematic study of the glacial features of Connecticut as a whole, and the results have been published in *Conn Geol and Nat Hist Survey, Bull* 47 (Hartford, 1930, pp 294) It is concluded that after the last invasion of the ice had reached its greatest extent, with its front lying along or south of Long Island, it passed into a 'dead' or stagnant state Once its power to move had gone the blanket of ice must have melted away from the surface downwards As more and more of the previously buried highland surface emerged, the ice was gradually left only in the valleys The melt-water made its way seawards through narrow channels left between the ice and the valley sides Terraces are left representing the marginal lakes of successively lower levels, the lakes having been filled up delta wise by deposits that were banked up against the ice margin The faces of the terraces are faithful casts of the irregular margins of the stagnant ice, and their surfaces are pitted with kettle holes representing isolated slabs of ice that were buried and afterwards melted out It is noteworthy that the terraces do not slope southwards with the stream gradients, but are quite horizontal This indicates that the differential tilting that uplifted the regions to the north did not affect Connecticut

Compensation of Ship's Direction Finders —In the early days of building iron ships, one of the greatest difficulties in the way of navigating them was to eliminate the effects of the ship's magnetism on the mariner's compass The most important effect is the 'semicircular' error, due mainly to the permanent magnetism of the iron girders, beams, and steel masts of the ship Another effect is the quadrantal error due to induced magnetism The first effect is corrected by placing two steel magnets in a certain position, and the second by two soft iron spheres placed one on each side of the compass In a paper on radio direction finders read by C E Horton to the Institution of Electrical Engineers on Mar 4, the methods of correcting their errors are discussed It is pointed out that these direction finders, like the mariner's compass, are affected by both semicircular and quadrantal errors The effects produced by the currents which flow in conducting paths in the ship have to be corrected by a loop suitably oriented and placed near the direction finder It has also to be shielded from the effects of the displacement currents in the dielectric by a subsidiary aerial coupled inductively to the direction finder This latter effect is corrected either by a fixed aerial system (Bellini Tosi) or a rotating coil system The semicircular error is due to the fact that although a ship is symmetrical about a central longitudinal line, it is not symmetrical about a transverse line The best position for the finder is as high above the hull as possible In some ships it is possible to put the coil on the top of the mast and above the level of other aerials In this position excellent results are obtained Whenever a blurred zero is obtained, it indicates the presence of a downcoming or atmospheric ray, and in this case the error of the apparent bearing may be large

Discharge through Sluices—Physical Department Paper No 25, issued by the Ministry of Public Works, Egypt, describes the experiments made under the direction of Dr H E Hurst, on three models of the sluices fitted in the Aswan Dam and Sennar Dam of the Nile Two of the models were to a scale of 1/50, and the other to a scale of 1/25 The experiments were made either at the School of Engineering, Giza, or at the Delta Barrage, while the total number of discharges measured during the work described in the paper was about 3700 Experiments were made under three conditions of flow free conditions, submerged conditions, and intermediate conditions, and the conclusion given is that the results show that the usual theory given in the textbooks on hydraulics is inapplicable, and that the flow through a sluice and culvert is complicated It can be described simply only when the flow is free or submerged, but not when the regime is intermediate between these

New Raman Effect Apparatus—The December issue of the *Indian Journal of Physics* contains a paper by Prof B Venkateschar and L Sibaiya, of the Central College, Bangalore, in which they describe a new apparatus for the study of the Raman effect in solids, liquids, and gases and mention some of the results they have obtained with it The material to be tested is enclosed in a short length of silica tube and placed at the centre of a long silica tube of 2 cm diameter, which is surrounded by a glass tube of 3 cm diameter The glass tube has a short tube projecting downwards filled with mercury, which serves as the cathode A bulb of about 5 cm diameter projects upwards from the long glass tube and has, at its centre, the tungsten anode When the mercury arc is formed, the part of the silica tube containing the specimen is entirely surrounded by it and the effect of the mercury line 2536 in the ultra violet may be observed By passing air at temperatures between 120° C and 400° C, through the silica tube, the effect of temperature on the Raman lines has been investigated for calcite, aragonite, and acetylene As would be expected, the lines become more diffuse with rise of temperature

Optical Properties of Mercury Solutions—A neat demonstration of the fact that mercury is soluble in water, methyl alcohol, and hexane is afforded by an investigation of the absorption of ultra violet light by such solutions, of which an account is given by K F Bonhoeffer and H Reichardt in the *Zeitschrift für Physik* for Feb 25 The absorption spectrum consists, in each case, of a pair of diffuse bands near the mercury resonance wave length (λ2537) The centres of the bands, if regarded as associated with λ2537, are displaced towards the red, but when the density of the liquid is reduced by superheating, the bands close in on each other and approach the resonance line The explanation offered of these observations is that the bands represent Stark components of the resonance line, the active electric fields being those of neighbouring molecules of the solvent, but it is difficult to account quantitatively for the magnitude of the effect. In the aqueous solution there is further absorption at about 2200 A, which has been tentatively ascribed to ionisation of the mercury

Conductivity Cells—In 1923 H C Parker published two papers which challenged a fundamental postulate of the Kohlrausch method for the measurement of the conductivity of electrolytes by the observation that the cell constant of a particular cell appears to vary with the resistance being measured The observation was confirmed by Randall and Scott in 1927, and some difficulty was experienced in accounting for it In the February number of the *Journal of the American Chemical Society*, Jones and Bollinger have examined the problem, and they show that the effect is caused by the use of the pipette form of conductivity cell, which has recently been much used by American workers and considered to have advantages over the older types of cell They show, both by calculations and experiments that with cells of this type there is a capacitative shunt between parts of the cell of opposite polarity, which has the effect of making the measured resistance lower than the true resistance of the electrolyte between the electrodes They also show that, whereas earlier experimenters have reported a variation in conductivity of electrolytes with change in frequency, no such change can be detected between the limits of 1090 and 4000 cycles per second, when the errors due to polarisation and capacitative shunt are avoided The design of the conductivity cell has been modified, and the resulting cells, which are very similar to the older types previously used, are said to be capable of giving very accurate results The ratio of the resistances of a pair of cells when filled with a common solution was found to be independent of the electrolyte used for three different electrolytes The peculiar effects which have been published in recent years would thus appear to have been due to experimental errors

Transition Temperature of Glauber Salt—The temperature at which the transition

$$Na_2SO_4, 10H_2O \longrightarrow Na_2SO_4 + \text{satd solution}$$

occurs has been measured by several methods by Oguri and co workers, the results being given in the *Memoirs* of the Faculty of Science and Engineering, Waseda University, Tokyo, No 7, 1930 The values are 32 46° (viscosity), 32 367° (dilatometer), 32 302° (solubility), 32 57° (static vapour pressure) and 32 57° (dynamic vapour pressure) The account of the dilatometric experiments includes a mathematical theory of the determination, in which it is shown how a more accurate value may be obtained from the results than by the usual simple graphical method

Silicic Acid Hydrosol—The preparation and properties of hydrosols of silicic acid are described in two papers by K Inaba in *Scientific Papers* of the Institute of Physical and Chemical Research Tokyo, Nos 278 279, for December The sols, prepared by the hydrolysis of ethyl silicate in presence of small quantities of inorganic acids and of alkalis respectively, showed differences in their properties The 'acidic sol' prepared in presence of acids could not be completely purified by electrodialysis, as it began to coagulate when the acid concentration was reduced to about 0 0002 *N*, whilst that prepared in presence of alkali could be perfectly freed from alkali by electrodialysis without causing coagulation, and is called the 'neutral sol' The acidic sol showed rather less conductivity and greater viscosity than the neutral sol Velocities of migration in an electric field were determined for those sols and for those prepared from silicon tetrachloride by hydrolysis and from sodium metasilicate and hydrochloric acid Acidic sols had a small degree of dispersion, small migration velocity and particle charge, whilst neutral sols had a great degree of dispersion and migration velocity The viscosity minimum produced on addition of electrolyte was situated in the neighbourhood of the isoelectric point The author is of the opinion that the peptising action of the chloride ion is important for stability, as well as hydration or charge, and is most powerful at the isoelectric point

The Royal Polytechnic Society, Cornwall

Amongst the oldest of provincial societies the Royal Cornwall Polytechnic Society which has its headquarters at Falmouth is one of those which has adapted itself to the changing times and continues to serve the interests of Cornwall in many ways. Instituted nearly a century ago for the sole purpose of holding exhibitions to encourage workmen and students and to give them the opportunity of showing their work, the annual exhibition and the summer meeting held simultaneously continue one of the Society's main activities. The scope of the exhibition held in July 1930 at Penzance is especially referred to in the ninety-seventh Annual Report of the Society, which records that the exhibition was visited by more than 6000 persons.

The Report also refers to the work of the Falmouth Meteorological Observatory, the Cornwall Rainfall Association with more than fifty observers in the county, and gives reports of the papers read at the summer meeting and some interesting biographical notes. Among these is a sketch of the career of the president, Dr. J. H. Rowe, of Bradford. Born in Hayle in 1870, Dr. Rowe graduated in medicine at Aberdeen and in 1899 began to practise in Bradford, where he has held the presidencies of the Bradford Literary Club, the Bradford Scientific Association, and the Bradford Historical and Antiquarian Society. He is, however, as well known in Cornwall as in Yorkshire, and possesses a unique collection of books, pamphlets, portraits, and documents relating to Cornwall, and his presidential address of last year to the Polytechnic Society was a review of the work of Cornish inventors.

In this address Dr. Rowe said that from a study of the records of some 350 inventors of Cornwall who previous to the year 1890 had invented objects of use or had taken out patents, he could not help drawing the reasonable inference that Cornwall in the past had had more than the average share of clever men. Among those to whom he referred more particularly were Robert Were Fox, inventor of the dipping needle; Davy, whose safety lamp had been the means of preventing countless accidents; Trengrouse, inventor of the unsinkable lifeboat, the cork jacket, and the rocket life-saving apparatus, who spent his fortune of £3500 on his inventions and died a poor man; Loam, inventor of the man-engine for raising miners from great depths; Trevithick, whose work was "brilliant, meteoric, sensational, but nevertheless effective"; Woolf, improver of the steam engine; Husband, whose pneumatic stamper for crushing minerals was first tried at Hayle Foundry in 1870; the Hornblowers, whose work is dealt with in a separate paper by Mr. R. Jenkins; Gurney, who invented the Bude Light and built steam carriages; the Tangye brothers; Roseveare, who in 1889 made the first wrist watch; and William Christophers, pattern maker of Hayle, who is said to have invented the spliced cricket bat and to have shown it to Lillywhite, through whom the invention became universally adopted.

Two of the papers included in the Report deal with Cornish copper and tin mining. The first, on "Tributers: their Uses and Abuses", is by Mr. A. K. H. Jenkin, and the second, on "Abandoned Cornish Mines", is by Mr. E. W. Newton, the secretary of the Society. A tributer is a miner who, in lieu of an ordinary weekly or monthly wage, agrees to work for a percentage of the total value of the ores he sends to the surface after paying the cost of all the tools and materials necessary for winning the same. The tributary system is of great antiquity and if tributers were properly encouraged they might continue even yet to stimulate Cornish mining. If recognition of their work is not made now, however, another decade or so and the race of men capable of rendering such services will have gone.

Mr. Newton's paper deals with the history of the Gwennap mines, which once employed many thousands of miners and from which many fortunes were made. The ores consisted of minerals rich in copper, such as native copper, oxides, arsenates, and grey sulphides. Connected with the Gwennap mines was the great County adit, begun nearly 170 years ago, "the finest and most extensive mining engineering feat carried out in Cornwall". Of the value of the mines Mr. Newton gives many particulars. South Wheal Jewel distributed £400,000 in profits in ten years; Wheal Virgin in 1757 produced copper ores in five weeks which sold for £15,000, at a working expense of £200; in 1806 Wheal Damsel was making a profit of £36,000 a year. The most fascinating mining adventure was the Wherry Mine, the shaft of which was off the coast near Penzance, 700 feet beyond high water mark. The tin ore was very rich, and it is said, "1 cwt. of white tin was obtained from a sack of ore". An American vessel breaking loose from her moorings demolished the works and the mine came to an end.

Crabs and Lobsters on the Coasts of Britain

An Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland to inquire into the Crab and Lobster Fisheries was set up in 1925 to examine the present position of crab and lobster protection in Great Britain. Its report, which has recently been published (London: H.M. Stationery Office, 1930, 1*s.* 6*d.* net), is based on statistics of landings and information as to the catching power employed in these fisheries. The scope of the inquiry was restricted to the eastern and southern coasts of England and the western coast south of the Bristol Channel and the Isle of Man. The Committee had also under consideration information as to the state of the fishing in various localities in England, and from the fishery districts in Scotland with local reports on the crab fisheries in 1923. These constitute a valuable basis for comparison with further data, taken together with landing statistics. It is recommended that similar inquiries into the catching power employed be held in 1932.

Investigations were undertaken by the Fisheries Department of the Ministry of Agriculture and Fisheries, with the co-operation of the local fisheries committees of England and Wales, to collect data with regard to size, sex, and condition of crabs. The object was to obtain definite information as to the immediate proportional loss which would result in various districts as a consequence of the introduction of measures intended to give further protection, such as increasing the minimum size at which crabs may be legally taken, prohibiting the use of undersized and soft crabs for bait, or the imposition of a close season where there is not one at the present time. After careful consideration, it was decided not to recommend the introduction of further statutory protective measures in respect of the crab fishery, as there is no falling off in the yields compared with

those of the pre-War years 1911–1913, but rather an upward tendency in the catches during more recent years. It was felt that an increase in the general size limit would entail an immediate loss of a serious nature to a section of the fishermen. As to the destruction of soft crabs, conditions are so different that if more legislation were necessary, close seasons would be different for different areas. It is, moreover, in the power of local fisheries committees to make bye-laws imposing further restrictions on the taking of crabs.

It is recommended that further inquiry into the migratory movements of the crab be pursued and special attention is directed to the experiments on the growth of the lobster at present being carried on at the Scottish Marine Biological Station at Millport. It is anticipated that much light on the life-history of the lobster will result from this work.

Appendices containing the various statistics, with bibliographies of literature relating to crabs and lobsters, are included in the report.

The Law and Practice of Treasure-Trove

THE law of treasure trove has been so ill defined in the minds of most working archæologists that we welcome the announcement made in the *Museum Journal* for April to the effect that negotiations on the subject which have been in progress for several years between H.M. Treasury and the British Museum have been brought to a satisfactory conclusion. The decisions of the negotiators have been embodied in a circular which, as defining the rights of the finder as well as his obligations, deserves the widest publicity. The circular, of which copies may be obtained on application to the Director, British Museum, W.C.1, is as follows: "Objects of *gold or silver* which have been *hidden* in the soil or in buildings and of which the original owner *cannot be traced* are Treasure Trove and by law the property of the Crown. (Unless, as in some rare cases, the 'franchise of Treasure Trove' has been expressly granted to a subject in so far as finds in the particular locality are concerned.) If, however, the finder of such objects reports the find promptly, and it is decided that it is Treasure Trove and therefore the property of the Crown, he will receive its *full market value* if it is retained for the Crown or a museum. If it is not retained, he will receive back the objects themselves with full liberty to do what he likes with them, or, if he wishes it, the British Museum will sell them for him at the best price obtainable. The only way in which a finder can comply with the law and also obtain these advantages is by reporting the find promptly to the proper authority.

"The proper authority is the Coroner for the district in which the find is made, for he is the authority who inquires 'of treasure that is found' and 'who were the finders' (Coroners Act, 1887, section 36.)

"Anyone, therefore, who finds such objects should report the find to the Coroner, either direct or through the local police, or by writing to the Director, British Museum, London, W.C.1, who will communicate with the Coroner.

"Coins and other ancient objects of copper, bronze, or any metal other than gold or silver are *not* Treasure Trove and finds need not be reported to Coroners. But the British Museum is glad to hear of such finds and, if finds are reported to the Director, will in suitable cases arrange for purchase or sale.

"Any further information may be obtained by applying to the Director, British Museum, London, W.C.1."

Symbiosis and Specificity in Lichens

IN an address at the meeting last year of the Swiss Society of Naturalists (Verhandlungen der Schweizerischen Naturforschenden Gesellschaft, 1930) Chodat gives an interesting survey of the history and recent advances in lichenology. As lichens are the only plants which, as a class, are characterised by a dual nature they are the outstanding examples of symbiosis—a term first used by De Bary, by which he did not intend to convey any idea of mutual effect of one symbiont upon the other, either for mutual benefit or the reverse.

It has usually been considered that in lichens there is a mutual effect and that this is more marked in the case of the fungus than in that of the alga, for the fungus can seldom if ever be ascribed to the same species as any free-living form, whilst in many cases the alga has been identified as belonging to some common species. According to some of the earlier workers such as Schwendener the specificity of the lichen was regarded as due to the fungus constituent, the algal gonidia in such different lichens as *Cladonia* spp., *Xanthoria parietina*, and *Parmelia* spp. all belonging to the one species *Cystococcus humicola*.

The recent work of Chodat and his co-workers and of Waren has shown that the algal gonidia cannot be ascribed so readily to free-living species as was previously thought. The conception has been shown clearly by pure culture work, from which it emerges that although the gonidia of various lichens may be of the same general type, for example *Cystococcus*, those isolated from different species of a lichen genus, for example *Cladonia*, are not identical with one another or with the free-living forms and often behave so differently in culture as to be recognisable by the macroscopic form of the colony. It has further been shown by Jaag that similar differences can be recognised between the gonidia isolated from different species of *Parmelia*, and it is especially interesting to find that the different types of *Cystococcus* isolated from *Parmelia* are more like one another than they are to the types of *Cystococcus* isolated from *Cladonia* species.

These facts are a little difficult to interpret and Chodat probably deals with the problem in the simplest way by regarding such different types of gonidial algæ as elementary species. Their identification suggests that the building up of a lichen is by no means haphazard but that it involves the coming together of a definite species of a fungus with a particular type or elementary species of alga and only with this one combination will a lichen of a particular species be synthesised.

Fatigue of Spring Steels

CONSIDERABLE trouble has been experienced by the failure in service of aero engine valve springs. A paper by Swan, Sutton, and Douglas, read before the Institution of Mechanical Engineers on Feb. 20, records an excellent piece of work on the factors which are involved.

The fractures, which were typical of fatigue failure, are ascribed to the stresses set up by 'surging' superposed on the already highly stressed wire, and were in many cases initiated as a result of some slight surface defect. Most of the wires showed surface decarburisation, and the removal of this layer resulted in an appreciable increase in the safe range of stress. Further, the temperature of quenching exerted a marked influence, and where this was high, longitudinal cracks were formed which resulted in premature failure.

Even in those cases where the surface layer had already been removed before heat treatment, the safe limits of stress in fluctuating torsion were still further increased by a further removal of the surface layer after that treatment. The probable causes of this phenomenon appear to be the detrimental effects due to further decarburisation, or the production of minute cracks or both. In steels containing elongated slag inclusions, heat treatment probably results in the formation of cracks at discontinuities and inclusions at the surface.

Another paper was read at the same time by Bateson and Bradley on the fatigue of laminated springs. Tests carried out on complete springs of this type have already shown safe ranges of stress of only 22–40 per cent of those which the materials would withstand in the form of turned and polished specimens. This weakness is clearly due to the surface layers of the plates of which the springs were built up. The thickness of this deleterious layer has now been shown to be quite small. It is practically completely removed by machining 1/16 in. from the surface, and in most cases it is probable that a much thinner layer of 0·01–0·015 in. would be sufficient. This surface effect has been found to be due to the hardening and tempering operations. Only a slight improvement, if any, results from heat treating the springs after the thin layer of steel has been removed from the surface of the rolled plate.

University and Educational Intelligence.

LONDON.—A course of five weekly lectures, which began on April 21, is being given by Sir John A. R. Marriott, on "The English in India, being the Essentials of the Indian Problem". The lectures are taking place in the University of London, Imperial Institute Road, South Kensington, S.W., and have been arranged by the University Extension Committee of the University. The first lecture was entitled "The Indian Background", this will be followed in succeeding weeks by lectures on "The English in India", "Constitutional Evolution under the Company", "Constitutional Evolution under the Crown", and "The Problem of India".

THE Quinquennial Congress of Universities of the Empire will be held next July. The main proceedings will take place in Edinburgh, but before this, several days will be spent in London by the delegates, where they will be received by the Prince of Wales at Guildhall on July 3. The London programme will include receptions by the League of Nations Union, the Victoria League, the English Speaking Union, and the University of London. Visits will also be made outside London, including the Universities of Oxford and Reading. The Congress will begin in Edinburgh on July 7. Addresses will be given by the Lord Provost of Edinburgh, Sir Donald Macalister, chancellor of the University of Glasgow, Lord Meston, chancellor of the University of Aberdeen, and Lord Beauchamp, chancellor of the University of London. Several subjects of general academic interest will be discussed, including "The University Graduate in Commerce and Industry", the standard and the conditions of candidature for Ph.D. in relation to other post-graduate qualifications, conditions of admission to Universities and their effects, the provision of schemes of study leading to general honours degrees, post-graduate study in medicine and surgery in Great Britain, and facilities for overseas students in British universities.

Birthdays and Research Centres.

April 26, 1879.—Prof. O. W. RICHARDSON, F.R.S., director of research in physics at King's College and honorary professor of physics in the University of London, Yarrow research professor of the Royal Society.

The researches to which I am now devoting most energy concern:

(1) The spectrum of hydrogen (H_2). This is of fundamental importance and interest owing to the simplicity of the structure of H_2 (2 protons and 2 electrons) and the richness of the spectrum. These researches have already provided the most accurate confirmation of the application of wave mechanics to a problem involving the interaction of more than two bodies. Mr. Williams and I have recently found that various band lines have different fine structures. In addition to its intrinsic interest, this should help to clear up the unclassified part of the spectrum.

(2) Soft X-rays. My chief immediate object here is to try to account for the puzzling discrepancy between the results got by optical and photoelectric methods.

(3) Electric emission resulting from chemical action. We have made great progress lately with this phenomenon, which, I think, is destined to shed much light on the nature of chemical action generally.

April 27, 1845.—Dr. D. W. FRESHFIELD, sometime president of the Alpine Club, the Royal Geographical Society, and of Section E (Geography) of the British Association.

I am chiefly interested in geographical education at the universities, and especially at Oxford.

May 1, 1882.—Prof. R. RUGGLES GATES, professor of botany in the University of London (King's College).

The lines of work now being carried on in my laboratory are mainly concerned with cytology and genetics, although work on plant physiology and biochemistry is also being done. Two investigators are working on the structure of chromosomes, and how and when the split takes place in mitosis. Another is investigating the floral development and cytology of the Australian acacias; another, the phenomena accompanying zygospore formation in Mucors, where it has been shown that, in certain cases at any rate, the medium plays a part in determining the conjugation or non-conjugation of two strains.

We are continuing on an extended scale the cytogenetic work with *Œnothera*, especially as regards chromosome linkage and the production of haploids. Several of my staff and students are partly engaged in this work, which promises to give further insight into the relations between chromatin and heredity.

As time and opportunity permit, I am continuing my work on heredity in man, racial crossing, and blood groups from anthropological, genetical, and eugenical points of view. An immediate need is the determination of the blood groups in the Siwash and other tribes of Indians in British Columbia.

May 2, 1868.—Prof. R. W. WOOD, For.Mem.R.S., professor of experimental physics, Johns Hopkins University, Baltimore.

Investigations of the absorption spectra of salts in anhydrous liquid ammonia are in progress, and certain new filters or colour screens for spectroscopic work have been found. Rather remarkable effects have been found with neodymium ammonium nitrate, the band in the yellow shown by a water

solution breaking up into five narrow components in the case of ammonia solutions A solid solution of neodymium oxide in fused quartz gives a most remarkable temperature emission spectrum, a fibre held in a Bunsen flame and viewed with a direct vision prism shows four bright bands (two red, an orange, and a green), separated by almost perfectly black intervals Eight bands have been photographed between wave-lengths 4000 A and 11,000 A

Work is going on also with the Raman effect The best filter for removing the line Hg 4046 is a solution of quinine in very dilute sulphuric acid It can be prevented from turning yellow (its chief objection) by a thin sheet of Corning noviol glass specified to absorb λ3650 and transmit λ4358 For removing the 4358 line a solution of iodine in carbon tetrachloride of proper concentration is used I now work with a horizontal quartz arc in a metal box, with the filter solution in a glass tube 6 cm in diameter and 25 cm long mounted horizontally between the arc and the tube containing the solution under investigation An electric fan blows the hot air column from the burner to one side

Societies and Academies

LONDON

Physical Society, Mar 6 —**G M B Dobson** A photoelectric spectrophotometer for measuring the amount of atmospheric ozone The instrument follows the usual practice of measuring the absorption by the ozone of solar ultra violet energy, from this measurement the amount of ozone can be deduced A double quartz monochromator isolates certain pairs of wave lengths, and the relative energy in the two wave lengths of a pair is measured by allowing them to fall alternately on to a photoelectric cell, the current from which is amplified by thermionic valves This allows great sensitivity to be obtained, so that very small amounts of light can be accurately measured For measuring the amount of ozone, a pair of wave lengths, one of which is strongly absorbed by ozone while the other is not, is selected It is shown how the amount of ozone can still be measured when the sky is cloudy if a second pair of wave-lengths, both unabsorbed by ozone, be also measured

EDINBURGH

Royal Society, Mar 2 —**B Prashad** Some noteworthy examples of parallel evolution in the molluscan faunas of south eastern Asia and South America The three families specially studied in this connexion are the Pilidæ (Ampullaridæ), Unionidæ, and Ætheriidæ In all three families there are species, externally almost identical, found in the two areas mentioned living under similar ecological conditions These almost identical types are believed to be the result of the action of the environment alone, and are regarded as examples of parallel evolution —**Henry Briggs**. The classification and development of the Carbonaceous minerals of organic origin A classification, based on the ultimate analysis, is applied to coals, cannels, paraffin shales, and torbanites All analyses are reduced to the basis C + H + O = 100 per cent A graphical method of presenting the analyses is adopted, it shows the above minerals to be distinct species, each following a 'development line' which expresses the evolution of the mineral from a rank equivalent to lignite to a rank equivalent to semi-bituminous coal With the exception of that of ordinary coals, the 'development lines' are straight, and each is oriented to a deoxygenated end-product of simple composition —**H V Lowry** Properties of the function $Ei_n(x)$ the function $\int_1^\infty \exp(-xt)t^{-n}dt$ which Milne called $Ei_n(x)$ in his book "Thermodynamics of the Stars", has also been used by Gold and Roberts in the discussion of some radiation problems In this paper some of the main properties of the function are discussed, including recurrence properties, expansions of the function in series, an approximation for large values of n, and a method of using least squares to find a function of the form $a\exp(-bx)$ which shall be close to $Ei_n(x)$ for all positive values of x —**A C Aitken** and **A Oppenheim** On Charlier's new form of the frequency function The probability, or relative statistical frequency, of a wide class of variables has been represented by the 'series of type A' The series is known, however, to have the practical defect that its terms do not decrease in regular succession, and C V L Charlier has recently advanced a modified form, type C, which he proves to be free from the defect in question, for the first several terms at least The authors demonstrate the truth of Charlier's conjecture that all the terms decrease in order Indirectly some abstruse theorems in combinatory algebra are brought to light

PARIS

Academy of Sciences, Mar 9 —**Mesnager** The bending of a beam does not depend on the shearing stress —**V Grignard** and **J Savard** The magnesium derivatives of dichlorotriphenylphosphine and on the pentaphosphines The chloride $C_6H_5\ PCl_2$ treated with the magnesium compound RMgX gives $C_6H_5PR_2$ The preparation and properties of $(C_6H_5)_3PCl_2$ are described, and also a new class of phosphorus compounds, the pentaphosphines, of the type $(C_6H_5)_3PR_2$, where R is an alkyl group —Elie Cartan was elected a member of the Section of Geometry in succession to the late P Appell —**Francesco Severi** A fundamental property of analytical functions of several variables —**Radu Badesco** Solution of a functional equation and generalised iterative functions —**Soula** Functions which possess an infinity of derivatives —**Basile Demtchenko** The inverse mixed problem and surfaces of sliding in doubly connected space —**O Yadoff** A new method of establishing the normal working diagram of turbines —**V G Siadbey** The apparent radiants of large meteors —**T Boggio** A physical interpretation of Riemann's tensor and of the principal curvatures of a variety V_3 —**P Vernotte** and **A Jeufroy** A simple method of measuring the specific heat of a solid at the ordinary temperature Application to beryllium The substance, at room temperature, is dropped into water at 1°–2° C contained in a Dewar vessel The calorimeter is standardised with a mixture of water and mercury of the same volume and heat capacity as the body under examination —**V Lalan** The hypothesis of the curve of pursuit and the laws of reflection in optical systems in motion —**R Jouaust** The problem of heterochrome photometry —**R Ricard** The various spark spectra of mercury —**G A Boutry** Modifications of the characteristic surface of a photoelectric cell with a gaseous atmosphere when the resistance in series is changed —**Guichard, Clausmann, Billon, and Lanthony** The independence of the hardness and proportion of hydrogen in electrolytic metals From the experiments described, the authors conclude that electrolytic metals do not owe their hardness, even partially, to the presence of a hypothetical hydride, their hardness is due to their very fine structure —**Néda Marinesco** Specific inductive power and molecular weight It is possible to deduce the molecular weight of a

dissolved colloid by a study of the dielectric dispersion of the system as a function of the wave-length Applied to a dilute solution of gelatine, the value for the molecular weight found was 11,300 —L Joleaud The recent progress of our knowledge on the history of the Pacific in the Tertiary period and Wegener's theory —D Schnéegans Observations on the western limit of the Briançonnais sheet to the south of the Maurienne —Mihailovitch Jélenko Two earthquake catastrophes, in November 1930 and January 1931, in Albania —Emile F Terroine and Miles Germaine Boy, Marguerite Champagne, and Gilberte Mouret The distribution of urinary nitrogen in the endogenous nitrogen metabolism specific during growth —Louis Baudin The respiratory quotient of fish as a function of temperature —Marcel Abeloos and Maurice Lecamp The production of abnormal and multiple formations in the limbs of Triton by the transplantation of regenerates —F Vlès and A de Coulon The final end of grafts of arrested epithelial tumours

SYDNEY

Royal Society of New South Wales, Dec 3 —**A R Penfold** The essential oils of three species of *Geijera* and the occurrence of a new hydrocarbon The essential oils from *Geijera parviflora*, *G Muelleri* and *G salicifolia* were examined Apparently two physiological forms exist in the species *parviflora* A new hydrocarbon of tentative formula $C_{11}H_{18}$ was isolated and several of its characteristics were examined —**J G Churchward** Studies in the inheritance of resistance to bunt in a cross between Florence and Hard Federation wheats Resistance to bunt is inherited as a simple Mendelian recessive A study of the occurrence of grass tufts in the progeny of the cross indicates the presence of an inhibiting factor A single dominant factor determines the inheritance of tip beardedness In the cross, Florence × Hard Federation, the inheritance of resistance to bunt, grass tufts, and tip beardedness is controlled by single, independent, Mendelian factors —**M B Welch** (1) Experiments on moisture in timber Experiments on the moisture content at different times of the year of certain flooring timbers at Sydney, show that a variation of approximately 2 0 per cent occurs between the maximum and minimum results The mean moisture content of twenty-six samples was 12 7 per cent, although individual samples varied from 14 8 to 10 1 per cent at different periods The mean moisture content of the softwoods is in general lower than that of hardwoods, which seldom give a mean figure below 12 5 per cent —(2) The occurrence of intercellular canals in the wood of some species of *Flindersia* Longitudinal intercellular canals of a gummosis type occur in the secondary wood of some species of *Flindersia*, notably *F Brayleyana* They are found in metatracheal parenchymatous bands, and form a more or less anastomising network extending in a tangential direction but not radially The contents appear to be similar to wound gum, the canals being formed by the breaking down of the cell walls Their origin is usually schizo lysigenous

VIENNA

Academy of Sciences, Jan 15 —**G Aigner** A graptolite fauna from the graywacke zone of Fieberbrunn in Tyrol, with remarks on the graywacke zone of Dienten Of 1200 specimens, some three per cent could be determined, thus ranking the shales with zones 18 22 of the English Silurian according to Elles and Wood —**B Kubart** Investigations on the flora of the coal basin of Ostrau-Karwin A *Lyginodendron* with marked medullary structure and zones of increase —**O Schindler** A new *Hemirhamphus* from the Pacific Ocean —**O Koller** The mammalian fauna of the Pithyusæ Islands —**A Steuer** Variation of size and form in the plankton copepods —**A Tamerl'** The osculating cylinder of rotation to a given three-dimensional curve —**J Hoffmann** The causes of different radiation colourings in glasses and of silic[illegible] and amethyst colourings —**W Abel** Investigations on the separate inheritance of the size of jaw and size of teeth in half-breeds from Bushmen, Hottentots, and Negroes The canines are sometimes crowded This is supposed to be due to the crossing of a large-toothed race with a small-jawed race The jaw is mesodermal, the teeth are ecto-dermal in plan —**K Menger** The concept of constructivity (2) The construction of series of arithmetical numbers

Jan 22 —**K Spitzer** Specific dopa-oxydases extracted from fruit In apple, pear, and banana there is a di-oxy-phenyl derivative which is most probably identical with 'dopa' (=di oxy-phenyl-alanin) —**E Schmid** The radium emanation content of open air and its vertical distribution near the ground (from observations in St Peter, near Graz, in 1930) The average content was less at a height of 50 metres than at 13 metres or 2 metres Also, the radium emanation concentration varied with meteorological conditions —**J Pia** Preliminary report on fossil Algæ, the results of a journey to England with the support of the Academy of Sciences The carboniferous limestone was studied in the field, in Gloucestershire, Yorkshire, and Westmorland, also in the museums of Bristol, Leeds, and London —**W Laves** Physico chemical studies of colour after experimental injury to the liver (1) The alteration of the electrostatic characters of nucleus chromatin and plasma of liver cells from injuries of the circulation and from direct action of high and low temperatures on the liver —**V Lebzelter** The anthropology of the Kung Bushmen Two main types and an intermediate were found

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 16, No 12, Dec 15) —Biotic cementation in coral reefs A distinction should be drawn between calcareous reefs and reefs actually built up by the co-operative growth of coral colonies, the skeletons of which become their chief component The Darwinian theory of coral reef growth refers to the second type of reef The solidarity of these reefs depends on organic cementation and the organisms concerned are nullipores —**W E Castle** The quantitative theory of sex and the genetic character of haploid males Certain hymenoptera, scale insects, and rotifers produce males which arise from unfertilised reduced eggs and transmit in their sperm only the female sex tendency It is concluded that they are genetically females though functionally they are sperm producers and are called males on the basis of their somatic character.—**Barbara McClintock** A cytological demonstration of the location of an interchange between two non-homologous chromosomes of *Zea mays* —**Sterling Emerson** The inheritance of *rubricalyx* bud colour in crosses with *Œnothera Lamarckiana* —**Harold H. Plough** Complete elimination of self-sterility in the ascidian *Styela* by fertilising in alkaline solutions. The block to self-fertilisation appeared to reside in the egg cortex itself —**G I Lavin** and **J R Bates**. The ammonia discharge tube An active gas is produced which is reducing in character, heats small solid particles in its path to incandescence, and causes an intense green glow in the ammonia collected in the liquid air trap Different metal and oxide surfaces show different effects in extinguishing the glow. The active gas seems to be a mixture of atomic hydrogen and a hydride of nitrogen (NH or NH_2).—**R. M.**

Badger and J W. Urmston: The separation of the two types of iodine molecule and the photochemical reaction of gaseous iodine with hexene Iodine and hexene were exposed to intense radiation from a mercury arc Compared with another tube containing fresh iodine and hexene, the experimental tube showed much weaker fluorescence with a mercury arc, suggesting that the type of iodine molecule responsible for this fluorescence had largely combined with the hexene —**George Scatchard** Note on the equation of state explicit in the volume —**Y H Woo** On the intensity of total scattering of X-rays by monatomic gases (see NATURE, Oct 4, 1930, p 501) —**H Bateman** Irrotational motion of a compressible inviscid fluid The discussion is applied to the case when the velocity is greater than the local velocity of sound and to the circulation round an aerofoil —**W J Trjitzinsky** A study of indefinitely differentiable and quasi analytic functions —**Tracy Yerkes Thomas** On the unified field theory (2) Another set of field equations is derived which indicates that Maxwell's equations hold approximately in the local co ordinate system in the presence of weak electro magnetic fields

Official Publications Received

British

The Veterinary Bulletin Vol 1, No. 1, April Pp 96. (Weybridge Imperial Bureau of Animal Health) 7s 6d net

The Imperial College of Tropical Agriculture The Principal s Report for the Year 1929-30 Pp. 24 Prospectus for 1931-32 and Register Pp. 27 (St Augustine, Trinidad , London 14 Trinity Square, E C 3)

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 18 The Influence of Frequency of Cutting on the Productivity, Botanical and Chemical Composition, and the Nutritive Value of "Natural Pastures in Southern Australia Progress Report on Co-operative Investigations at the Waite Agricultural Research Institute Pp 28. (Melbourne H J Green.)

Seale-Hayne Agricultural College, Newton Abbot, Devon Department of Plant Pathology Seventh Annual Report for the Year ending September 30th, 1930 (Pamphlet No 36) Pp. 86 (Newton Abbot.)

Transactions of the Royal Society of Edinburgh Vol 56, Part 3 No. 29 On the Morphology, Feeding Mechanisms and Digestion of *Ensis siliqua* (Schumacher). By Alastair Graham Pp 725 751+1 plate 3s. 6d Vol 56, Part 3, No 30 The Dolerite Isles of the North Minch By Dr Frederick Walker Pp. 753 766+1 plate. 2s. (Edinburgh Robert Grant and Son London Williams and Norgate, Ltd)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 6, No 2, April Pp 133-220 (Cambridge At the University Press) 12s. 6d net.

The Photographic Journal. Vol 71, New Series, Vol. 55, April Photography in Science, Art and Industry Pp. 133 166+56+xlvi+9 plates. (London The Fountain Press, Ltd) 2s. 6d.

British Guiana Second Legislative Council First Session, 1930, Geological Survey Report on the Buck Canister-Oranapai Section of the Maraxuni Diamond Field Pp 18 (Georgetown, Demerara Department of Lands and Mines.)

Reports of the Council and Auditors of the Zoological Society of London, for the Year 1930, prepared for the Annual General Meeting to be held on Wednesday, April 29th, 1931, at 4 P M Pp 91 (London)

Goitre in the Light of Recent Research By Prof C E Hercus (Cawthron Lecture, Sept. 5th, 1929) Pp. 22+10 plates. (Nelson Cawthron Institute)

Researches in British Guiana, 1926-1928, on the Bacterial Complications of Filariasis and the Endemic Nephritis with a Chapter on Epidemic Abscess and Cellulitis in St. Kitts, British West Indies By A W Grace and Feiga Berman Grace (Memoir Series, No. 3) Pp. viii+75 (London London School of Hygiene and Tropical Medicine.) 8s

Anopheline Mosquitos in Southern Rhodesia, 1926-1928 a Report on Investigations made during Researches on Blackwater Fever conducted by Dr G R. Ross By H S. Leeson. (Memoir Series, No 4) Pp ix+55+15 plates. (London London School of Hygiene and Tropical Medicine) 8s

Foreign

U S. Department of Commerce Coast and Geodetic Survey Serial No. 499 Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Tucson, Arizona, in 1923 and 1924. By W N McFarland Pp. ii+108 (Washington, D C Government Printing Office.) 50 cents.

Publikationer og mindre Meddelelser fra Københavns Observatorium Nr 72 Über die kritische Masse im problème restreint und über das problème restreint im allgemeinen. Von Elis Strömgren. Pp. 6 Nr 74. Bestimmung der Bahn des periodischen Kometen Comas Solá (1926 f). Von Julie M Vinter Hansen Pp. 25 (København)

Bulletin of the American Museum of Natural History Vol. 59, Art. 5 A new Classification of Mammals By George Gaylord Simpson Pp. 259-293. (New York City)

Report of the Danish Biological Station to the Ministry of Shipping and Fisheries No. 36, 1930 By Dr A. C Johansen Pp. 96. (Copenhagen C. A. Reitzel)

Proceedings of the United States National Museum. Vol 78, Art. 17 Mollusks from the Aspen Shale (Cretaceous) of Southwestern Wyoming By John B Reeside, Jr , and A Allen Weymouth. (No 2860.) Pp 24+4 plates. (Washington, D C Government Printing Office)

U S Department of Commerce Bureau of Standards. Miscellaneous Publication, No 114 Filters for the Reproduction of Sunlight and Daylight and the Determination of Color Temperature By Raymond Davis and K. S Gibson Pp. 165 (Washington, D C Government Printing Office.) 45 cents

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 3, No 3, Mars. Pp. 135 186. (Prague Regia Societas Scientiarum Bohemica)

Publikationer fra det Danske Meteorologiske Institut Communications magnetiques, etc , No 13 A Theoretical Determination of the Heights of the Stratosphere, the Ozone Layer and the Height of Maximum Luminosity of the Aurora By Helge Petersen Pp 19 (København G E C Gad)

Proceedings of the American Academy of Arts and Sciences. Vol 66, No 5 The Volume of Eighteen Liquids as a Function of Pressure and Temperature By P W Bridgman. Pp 185-233 1 dollar Vol 66, No 6 The Problems of Lagrange and Mayer with Variable End Points. By Marston Morse and Sumner Byron Myers Pp 235 253 45 cents. Vol 66, No 7 Compressibility and Pressure Coefficient of Resistance, including Single Crystal Magnesium By P W Bridgman Pp. 255 271 45 cents (Boston, Mass)

Mémoires publiés par la Direction Générale des Télégraphes de Suède Étude des courants telluriques Par Dr David Stenquist. Deuxième fascicule Pp 17 (Stockholm R W Statlanders Boktryckeri)

U S Department of Agriculture Farmers Bulletin No 1644 Local Bird Refuges By W L. McAtee Pp ii+14 (Washington D C Government Printing Office) 5 cents

U S Department of Commerce Bureau of Standards Research Paper No 262 Prism Size and Orientation in Minimum Deviation Refractometry By L W Tilton Pp 59 76. (Washington, D C Government Printing Office) 10 cents

U S. Department of the Interior Geological Survey Water Supply Paper 637 B Preliminary Report on the Ground Water Supply of Mimbres Valley New Mexico By Walter N White (Contributions to the Hydrology of the United States 1930) Pp ii+69 90+1 plate Bulletin 821-C Iron Ore on Canyon Creek, Fort Apache Indian Reservation, Arizona. By Ernest F Burchard (Contributions to Economic Geology 1930 Part 1) Pp ii+51 78+plates 14 18 15 cents (Washington D C Government Printing Office)

Division of Fish and Game of California Fish Bulletin No 27 The Ring Net, Half Ring Net, or Purse Lampara in the Fisheries of California. By Donald H Fry Jr (Contribution No 101 from the California State Fisheries Laboratory) Pp 67 (Sacramento California State Printing Office)

Proceedings of the United States National Museum Vol 78, Art 7 A Revision of the Species of Coccophagus a Genus of Hymenopterous, Coccid inhabiting Parasites. By Harold Compere (No 2850) Pp 132+14 plates. Vol. 78, Art 18 A new Species of Amphipod Crustacean (Acanthonotozomatidae) from California, and Notes on *Eurystheus tenuicornis* By Clarence R. Shoemaker (No 2861) Pp 8 Vol 78, Art. 23 Redescription of Two Species of Trematode Worms from the MacCallum Collection with a Note on the Family Pronocephalidae By Emmett W Price (No 2865) Pp. 10 Vol 78 Art 28 New Genera and Species of Nematode Worms By Asa C Chandler (No 2866) Pp. 11 (Washington D C Government Printing Office)

Science Reports of the Tokyo Bunrika Daigaku, Section A No 6 On the Vapour Pressure of Liquid Part 2 On the Vapour Pressure, Henry s Constant and Osmotic Pressure of Concentrated Solutions By Koiichi Watanabe Pp 67 84. (Tokyo Maruzen Co , Ltd) 30 sen

Field Museum of Natural History Botanical Series Vol 10 Flora of the Lancetilla Valley Honduras By Paul C Standley (Publication 283) Pp 418+68 plates Botanical Series, Vol 8, No 4 The Cyperaceae of Central America. By Paul C Standley (Publication 284) Pp 239 292. Botanical Series, Vol. 7, No 2 The Rubiaceae of Ecuador By Paul C. Standley (Publication 285) Pp 179 251 Zoological Series, Vol 18, No 2 Bats from Polynesia, Melanesia and Malaysia By Colin Campbell Sanborn (Publication 286) Pp 7 29 (Chicago)

Proceedings of the Imperial Academy Vol 7, No 2, February Pp. iii v+29-83 (Tokyo)

Scientific Papers of the Institute of Physical and Chemical Research No. 288 Note on the Photoelectric Effect by Relativistic Wave Equation of Dirac. By Toshinosuke Muto Pp. 111 126 25 sen No 292 Der Einfluss metallischer Überzüge auf die mechanischen Eigenschaften von Stahl beim Nitrieren. Von Tadamasa Yosiki Pp 143 154+plate 5. 25 sen. No 293 On the Constitution of Tea Tannin By Michiyo Tsujimura Pp. 155-159+plate 6 15 sen Supplement No 15 Eine einfache graphische Method für die Berechnung des partiellen spezifischen Volumens von Eiweisskörpern Von Tominosuke Katsurai Pp. 7-8 10 sen (Tōkyō Iwanami Shoten)

Bulletin of the National Research Council No 77 Physics of the Earth 1 Volcanology By the Subsidiary Committee on Volcanology Pp viii+77 75 cents No. 78 Physics of the Earth 2 The Figure of the Earth A Collection of Short Papers, written by Leading Scientific Men in several branches of Geophysics, and treating of the Size and Shape of the Earth Pp. v+286 3 50 dollars. No 79 Physics of the Earth 3 Meteorology Prepared under the Auspices of the Subsidiary Committee on Meteorology Pp xi+289 3 50 dollars. (Washington, D C National Academy of Sciences.)

U S Department of Commerce Bureau of Standards. Bureau of Standards Journal of Research. Vol. 6, No 3, Research Papers Nos. 279-291 Pp. 355-522. (Washington, D C Government Printing Office.) 40 cents.

Smithsonian Institution Explorations and Field Work of the Smithsonian Institution in 1930 (Publication 3111) Pp iv+224 (Washington D C Smithsonian Institution)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 83 East African Birds collected during the Gray African Expedition, 1929 By W Wedgwood Bowen Pp 11 79+plates 2 12 The Cirriped Genus *Pyrgoma* in American Waters By Henry A Pilsbry Pp 81 83. Nearctic Vitreine Land Snails By H Burrington Baker Pp 85 117 (Philadelphia)

U S Department of Commerce Coast and Geodetic Survey Special Publication No 171 World Longitude Determinations by the United States Coast and Geodetic Survey in 1926 By Clarence H Swick Pp ii+29 (Washington, D C Government Printing Office) 15 cents

U S Treasury Department Coast Guard Bulletin No 20 International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1930 Pp iv+60+11 plates (Washington D C Government Printing Office.)

Smithsonian Miscellaneous Collections Vol 82, No 16 The Ductless Glands of Alligator Mississippiensis By A M Reese (Publication 3110) Pp 14+8 plates (Washington, D C Smithsonian Institution)

Transactions of the Astronomical Observatory of Yale University Vol 6 Part 4 Theory of the Eighth Satellite of Jupiter By Ernest W Brown Pp 47-65 (New Haven, Conn)

Diary of Societies.

FRIDAY, APRIL 24

ROYAL SOCIETY OF ARTS (Indian Meeting) at 4 30 —Sir William Foster John Zoffany in India.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Westminster Hospital), at 4 30

INSTITUTE OF MARINE ENGINEERS, at 6 —Annual General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6.15 —E J Mathieson The Generation and Uses of Electrical Power in a Modern Colliery

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Waldorf Hotel, Aldwych) at 6 45 —At 7 30 —Sir Richard Gregory Bart Science in Industry

BRITISH ASSOCIATION OF CHEMISTS (Scottish Section) (at Central Halls Glasgow), at 7 30 —Annual General Meeting

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8 —Col L W Harrison Epidemiology of Venereal Diseases

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Sir Philip Hartog Joseph Priestley and his Place in the History of Science

SATURDAY APRIL 25

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle upon Tyne), at 2 30 —T C Futers Notes on a Recent Visit to South Africa with the Empire Mining and Metallurgical Congress Witwatersrand Gold Mines Coal, Asbestos, and other Mines Diamond Mines (Lecture).—Paper open for further discussion —Old Mining Records and Plans T V Simpson

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4 —E Ronceray Sand, and Sand Preparation

MONDAY, APRIL 27

INSTITUTE OF ACTUARIES at 5 —K J Britt Amalgamations of Life Assurance Companies.

ROYAL INSTITUTE OF BRITISH ARCHITECTS at 8 —M Ayrton Modern Bridges.

ROYAL SOCIETY OF ARTS at 8 —Dr N A V Piercy The Present Position in Aeronautics (Howard Lectures) (3).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8 —W Charles Full Denture Prosthesis

TUESDAY, APRIL 28

EUGENICS SOCIETY (at Linnean Society) at 5 30 —Dr A J Lewis Genetic Problems in Psychiatry

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Dr W E Le Gros Clark The Brain of *Microcebus murinus*.—C Elton, E B Ford, J R. Baker, and A D Gardner The Health and Parasites of a Wild Mouse Population —Dr C J van der Klaauw On the Tympanic Region of the Skull in the Mylodontinæ —R Anthony Vestiges de deux remplacements successifs de la 3ème molaire de lait chez l Eléphant d Asie (*Elephas indicus* Cuv).—D Aubertin Revision of the Genus *Hemypyrellia* Tns (Diptera Calliphoridæ).

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at 28 Portland Place, W 1), at 6 30 —H Lesser and others Discussion on Personnel Policy and Administration

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —Symposium on Sensitometry —Dr W Clark General Considerations of Sensitometry as Applied to Sound Recording —C R. Keith Sensitometry in the Modern Film Laboratory —G S. Moore Precautions in Practical Sensitometry —Miss G Geoghegan Demonstration of the Tallent Reflection Density Comparator

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30.—Gossip Meeting

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30 —A L. Armstrong Recent Excavations in the Pin hole Cave, Cresswell Crags

ROYAL AERONAUTICAL SOCIETY (Students Section).—E Wieser Airships (Lecture).

WEDNESDAY, APRIL 29

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W C 1), at 6 —Miss Evelyn Cheesman In the Savage South Seas (Lecture).

ROYAL SOCIETY OF ARTS, at 8 —Sir Harold Carpenter Stainless Metals

THURSDAY, APRIL 30

ROYAL SOCIETY, at 4.30 —Dr A. E H Tutton Determination of the Yard in Wave Lengths of Light.—U R. Evans, L. C Bannister, and S C Britton The Velocity of Corrosion from the Electrochemical Standpoint.—T L. Eckersley On the Connexion between the Ray Theory of Electric Waves and Dynamics.

LINNEAN SOCIETY OF LONDON, at 5 —Dr G S Carter Aerial and Aquatic Respiration —Dr E S Semmens Hydrolysis in Living Plants by Polarised Light Effect of Blue Skylight on Plant Metabolism —Dr J M Dalziel Hairs Lining the Loculi of Fruits of Species of *Parinarium*

INSTITUTION OF ELECTRICAL ENGINEERS at 6 —Presentation of the Faraday Medal to C H. Merz —Prof W L Bragg The Architecture of Solids (Kelvin Lecture).

INSTITUTION OF LOCOMOTIVE ENGINEERS (at Institution of Mechanical Engineers), at 6 —Miss V W Holmes A New and Infinitely Variable Poppet Valve Gear

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30 —Dr M Curry Aerodynamics of Sails (Lecture)

FRIDAY, MAY 1

CERAMIC SOCIETY (Building Materials Section) (at Imperial College of Science and Technology), at 10 30 A M —M Barrett Night Architecture —W A McIntyre Durability of Terra Cotta with Particular Reference to the Filling of Blocks —M Barrett Stock Terra Cotta —M Barrett Metallised Terra Cotta —At 2 30 —E R F Cole Kiln Products in Architecture —G Haworth Informal Talk on Modern Machinery Used in Three Processes of Brick making, i e Semi plastic, Stiff plastic, and Plastic Wire Cut.—W Emery Notes on the Firing of a Blue Brick Oven

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting) at 10 30 A M —Dr Schmaltz The Physical Phenomena Occurring in the Semi circular Canals during Rotatory and Thermic Stimulation —Dr H W Barber Eruptions Involving the External Auditory Meatus —Discussion Non malignant Diseases of the External Ear and Auditory Meatus

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4 30 —Dr G M B Dobson Variations and Distribution of Atmospheric Ozone

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —Prof J E Lennard Jones Cohesion (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN at 5 —Annual Meeting

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Annual General Meeting), at 5 - Prof G Portmann A Big Tumour of the Deep Regions of the Face Removed by Operation, with Cure —Dr A Brown Kelly, Dr D R Paterson, and others Discussion on Obstruction at the Upper End of the Œsophagus (Excluding Pharyngeal Diverticula)

ROYAL SANITARY INSTITUTE (at Town Hall Batley), at 5 —Councillor H Crothers and Councillor H S Houldsworth Housing, with Special Reference to the Housing Act, 1930, from the Aspect of a Town Councillor —Dr T Gibson and H Hornby Housing, with Special Reference to the Housing Act, 1930 from the Administrative Standpoint

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at Royal Society of Arts) at 6.—Miss S. Bevington The Causes of Juvenile Drifting —A. H Seymour Personnel Work in Modern Industry

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7 —Prof W M Thornton High Voltage Precision Measurements (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —H Crowe and others Discussion on Hydraulic Valves

GEOLOGISTS' ASSOCIATION (at University College), at 7 30 —Prof P G H Boswell The Glacial Deposit of East Anglia, with Especial Reference to the Industries of Early Man

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8 30 —Annual General Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof D Arcy W Thompson Charlotte Brontë in Brussels.

SATURDAY, MAY 2

ROYAL SANITARY INSTITUTE (at Town Hall, Batley), at 10 A M —Major D S Rabagliati and others Discussion on The Practical Value of Meat Inspection

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (at Cambridge).

PUBLIC LECTURES

TUESDAY, APRIL 28

LONDON SCHOOL OF ECONOMICS, at 5 —Prof L. Hogben Some Aspects of Human Inheritance (1) The Biology of Twinning

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Prof F A E Crew Laws of Inheritance (Succeeding Lectures on April 29, 30, and May 1)

WEDNESDAY, APRIL 29

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 30 —Prof O Förster Neurology (Succeeding Lectures on April 30 and May 1)

THURSDAY, APRIL 30.

UNIVERSITY COLLEGE, LONDON, at 5 30 —M Aubert Les origines de la Voûte sur Croisée d Ogives. (Succeeding Lecture on May 1)

FRIDAY, MAY 1

UNIVERSITY COLLEGE, LONDON, at 5.—Prof B Ashmole History of Ancient Sculpture

SATURDAY, MAY 2, 1931

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Medicine and Science.

THE advancement of medicine is an object which can scarcely fail to be universally desired, and the discussion of the principles that govern it is therefore a matter of perennial interest It is in itself an evidence of healthy life that such discussion should have been active of late and should have been contributed to influentially from several different aspects *

The fundamental process at work in progressive medicine to day is the gradual acquisition by it of the qualities of an applied science Although this development must be regarded as the inevitable course of sound advance, it is beset by certain difficulties inherent in the very nature of the case which give to the situation of medicine a special interest from the point of view of method One of these difficulties is the result of what we may call the historical setting in which science applied to medicine finds itself

When science is given a wholly new contact with practical affairs, the applied science that thereupon grows up develops, as it were, in virgin soil, with nothing to hope from the co operation or to fear from the conservatism of any antecedent practical art in the same field In these circumstances, the new activity may develop uneventfully as a straightforward applied science, such, for example, has been, from this point of view, the situation of electrical engineering When science is applied to a field already occupied by a vigorous practical art, however, the contact of the two different disciplines may result in a certain wasteful discrepancy of ideals and effort In some degree this has been the situation of scientific agriculture in its relation with the ancient practical art of farming, it is still more clearly the situation of applied science in medicine Here science finds the ground already occupied by one of the most ancient, vigorous, and learned of the practical arts It must be recognised that the two disciplines, although in favourable circumstances capable of most fruitful co-operation, do not possess any strong natural affinity for one another One of the aspects of this relative incompatibility is shown in the inveterate endeavour of science to bring every individual problem within the range of principles of general validity, while the strength of the practical art is its regard for the uniqueness of the individual case

* The following contributions may be mentioned both for their importance and their representative variety of outlook Observations on Research in Medicine , by Sir Thomas Lewis, *Brit Med Jour*, Mar 15, 1930, "A Discussion on Research in Clinical Medicine" by Dr J Ryle and others, *Proc Roy Soc Med*, Oct 28, 1930, "The Science of Medicine", by Lord Moynihan, the *Lancet*, Oct. 11, 1930

A second obstacle that applied science in medicine has to overcome is inherent in the biological situation of man. It is the consequence of the wide gap in structure, and still more in function, that separates man from any other animal. The extent of this separation has perhaps not always been fully recognised; it is, however, undoubtedly of importance, not only in complicating the application to man of the results of animal experiment, but also because of the doubt it raises whether certain activities of man on which knowledge is urgently needed by medicine can even be illustrated, much less elucidated, by experiments on animals. The recognition of this difficulty has caused greater and greater attention to be given to the use of direct experimentation in man himself—the only means of acquiring knowledge about him that from the point of view of method is wholly unexceptionable. It is, however, of necessarily limited range, so that for the general progress of knowledge in scientific medicine we must continue to depend chiefly on animal experiment and on our ability to apply its results to man.

Although man's place in Nature has been and still is a favourite theme of the post-Darwinian biologist, it has, for reasons historically obvious, very naturally been defined chiefly with an eye to structure and to unities and resemblances with the rest of the living world. The time has now come when in the interests of medicine a more exact and critical orientation is necessary, which must concern itself essentially with function and not less with dissimilarities than with likenesses. On the elaboration of such a science of comparative function in health and in disease the progress of medicine is likely to come more and more to depend. Much of the material for such a study exists already in the immense accumulation of the facts of human behaviour made by clinical medicine from time immemorial.

In this connexion, some comment on the general value of the clinical method as an implement of research should perhaps be made. There can be no doubt that, as a method of fundamental inquiry, that characteristic of the clinical physician has been far outdistanced by that of strict scientific experiment. This fact has led to the suggestion that the time honoured method of the clinician, the method of Addison and Bright, of Paget and Hughlings Jackson, has little or nothing to offer for the future of medicine. Since the acceptance of this doctrine could scarcely fail to have important practical consequences, some examination of it is desirable. The great strokes of the clinical method have usually been made by the use of observation acute and patient rather than systematic, with a certain amount of not very strict experiment, both guided by a penetrating intuition and a profound familiarity with the subject of inquiry. These successes have therefore been won by men whose mental powers enabled them to use an imperfect instrument with a certain large indifference to its defects. Lacking the intuition of his great predecessors, the clinical worker must pay more attention to perfecting the instrument if he is to get substantial results. Every opportunity to introduce standards of scientific severity must be taken, observation must be systematic and exact, and the most must be made of any occasional chance to submit an issue to experiment. Purely clinical inquiry never has been and never can be the equal of experiment in the attack on a problem stage by stage until a final solution is reached, but if every opportunity is taken to naturalise in it standards of scientific severity, it has within its range innumerable important problems that it should be thoroughly able to solve.

Whatever successes may await a clinical medicine thus oriented more definitely towards the standards of science, there can be no doubt that it is the experimental method, in all its severity and in the hands of the appropriately educated expert, on which the substantial progress of medicine essentially depends. How best this great instrument can be directed upon the work before it is a matter on which very naturally there is difference of opinion. Perhaps the most important practical problem yet in discussion is to decide the relative claims of what have been called 'free' research and 'directed' research: that is to say, inquiry which follows the natural evolution of its subject, and inquiry in which specific problems are allotted to the worker for solution. There can be no question that in the sciences on which medicine depends, as in all other sciences, complete freedom of research is indispensable; however academic, however remote from any kind of usefulness inquiry following its own course may seem to become, any restraint, in the supposed interests of practical ends, is wholly inadmissible. There is, however, another aspect of the case which must be considered. The practical clinician finds himself surrounded by problems which seem soluble by skilled experiment and of which solutions are urgently necessary in the interests of his art. He sees that the great bulk of research in physiology and even pathology has little or no direct bearing on his immediate difficulties. Aware as he is that one of the most effective

instruments used by these sciences—operative surgery—was given to them by his own art, he cannot but feel that the debt might be repaid in some more tangible form than has yet been the case

The demand by the clinical worker that in his special problems he should have at his disposal the full advantage of skilled experimental research, just as it doubtless is, can obviously not be met by deflecting resources now devoted to 'free' research It seems to call for establishments specially directed to the purpose and staffed in part by those whose ultimate interests are likely to be in some branch of the practical art, but who by serving an apprenticeship in experimental science would contribute to the advancement of practical medicine directly by working on its problems and indirectly by infiltrating its ranks with the scientifically trained In a remote way, the same interests, as well as those of the whole of human biology, are being served by that re discovery of man which is now so happily at work in the physiological and pathological fields It is earnestly to be hoped that this process will continue, for by bringing clinical and scientific workers together it will help the experimental sciences in their not always successful struggle against orthodox rigidity, and will help the ancient practical art of medicine in its difficult transformation into an applied science

The Anthropology of Africa

Descriptive Sociology or Groups of Sociological Facts classified and arranged by Herbert Spencer Division 1, No 4, Part 2 A *African Races (Pygmies, Bantu, Equatorial Hybrid Tribes, Sudanic Peoples, Nilotics, Nilo-Hamitics, Fulani, Khoisan)* Compiled and abstracted upon the Plan organized by Herbert Spencer by E Torday A re issue of the Volume originally compiled by Dr David Duncan, entirely re written Issued by Mr Spencer's Trustees (T W Hill, Editor) Pp vii + 385 (London Williams and Norgate, Ltd, 1930) 105*s* net

ONE of the most telling symptoms of vitality in science is the fruitfulness of its practical applications Anthropology, the science of man, has so far kept almost completely aloof from any direct concern in human affairs, as sublime an example of sterility beautiful as the theory of numbers But this is an anomalous condition, and at present public interest as well as political conscience are moving towards a better understanding of the governed races so that they might be better governed

The centre of colonial studies at Oxford, Rhodes House, the International Institute for the Study of African Languages and Cultures, with its principal seat in London, developments at various universities in Great Britain, and such valuable literary contributions as Buell's "Native Problem in Africa", are all signs of this gathering interest

It is only fair that an anthropologist, specially keen about the practical applications of his science, should pay tribute to NATURE for the part it has taken in the movement of humanising anthropology and making it more efficient If anthropology ever becomes an acknowledged force in colonial affairs and receives the full academic recognition which is its due, this will be, to a considerable extent, thanks to the good offices of NATURE At present it is well to put on record that there is but one full time chair of anthropology in the British Isles, the teaching of colonial cadets is not carried out at all in the University of London, where this chair exists, and in those universities where the colonial probationers are trained, anthropology is an optional subject and is confined to what must be a ridiculously inadequate smattering of twenty hours in all This, of course, is negligible, especially if we remember that in other countries, with a colonial tradition as long as that of Holland or France or as short as that of Belgium, from three to five years are required for the special training of future administrators This does not mean to say that an anthropologically trained Belgian administrator has shown himself so far to be better than an untrained Britisher, but that the educated British official would probably be the best of all

The present volume, Mr E Torday's "African Races", brings these reflections to the reader's mind The book deals with Africa, which is by far the most important continent as regards colonial problems, and it is written by a scholar of international reputation Mr Emil Torday is at once a pioneer field-worker, a man of full academic qualifications, though without formal academic claims, and one of the supporters of what is now known as the 'functional school of anthropology', a school which has been foremost in the application of anthropological theory to practical affairs

The functional school explains institutions, customs, and beliefs, not by their antecedents but by the part which they play as living forces within a living culture Functional anthropology consists in new methods and a body of principles which have arisen out of field-work, and which,

on the other hand, are largely inspired by the need for practical applications Modern field-work, done by trained specialists with a good knowledge of native languages and over periods of prolonged residence, has forced us to recognise that whereas it is easy to collect a body of formulæ as to what natives are supposed to do, it is difficult to describe how ideas, customs, and institutions actually work in tribal life The dynamic study of a primitive society reveals that human culture is a very complex type of reality, subject to scientific laws of its own The discovery of the laws of cultural process and of the functional relation between its various aspects and elements is the main field of functional theory

A theory giving clear insight into the nature of culture is indispensable for anyone who sets out to make observations on a hitherto unrecorded type of human society No student of exact science or of biology would dream of sending a plumber or a bookmaker or a lady typist into the laboratory and of relying upon his or her amateur observations Experiments done without theoretical preparation or knowledge of the problems would, as a matter of course, be regarded as worthless in physics, chemistry, or biology Yet in anthropology we have so far been forced to rely on amateur observations, often given without any description of the method and the apparatus by means of which they were made

Worse than that when trained specialists recently started to collect their own material in Africa, Oceania, or the South American jungle, they had no empirical theory as to the nature of primitive culture, that is, of the reality which they were setting out to observe What they were given were hypothetical speculations of the retrospective schools, the evolutionists and the diffusionists But the theories of origin or of historical migrations transplant us in their explanatory setting into a dim past—from six to sixty thousand years back The observer, as often as not a partisan of one theory or another, had his mind turned backwards, riveted on hypotheses and conjectures which made him see the present through the haze of the past, which made him focus on details and elements significant not in their actual context and in their mutual relations, but as relics of something which was no more and, except in speculation, had perhaps never existed

Functional anthropology aims at the reproduction of the native point of view and the native perspective combined with sociological knowledge of what is essential and vital in human institutions. The details of daily life, for example, the organisation of the household and the family, the type of economic activities, the sanctions of law and custom, which so far have received but little attention, have come to be, in functional research, of primary importance All that really matters to the native, all that really serves to maintain order and integrity in a primitive culture and primitive society, is selected as the main object for anthropological study It is clear that such a reorientation of field work and theory al[illegible] by the criteria of dynamic relevancy brings functional anthropology immediately into touch with practical concerns

Mr Emil Torday is one of the pioneer minds in this new school His field-work, carried out under ideal conditions, that is, during prolonged residence and through the medium of the vernacular, gives us a full picture of tribal life and is never confined to curious and sensational details

In the present computation of facts, Mr Torday proceeds throughout according to the rules of the functional method, that is, by the criteria of relevancy, function, and social value As is the case in all scientific work, it is the selection which really matters, the emphasis on the relevant, the subordination of the accidental In doing this, Mr Torday had an ardous task, for he was severely handicapped by the exacting conditions of the Herbert Spencer Trust, which lays down the subject matter, the headings, the order, as well as the relation between the geographical and the systematic divisions of the material By the introduction of a concise but extremely helpful table of contents, by adding illuminating subheadings and cross-references, Mr Torday was able to palliate some of the inadequacies of the original Herbert Spencer plan By adding copious critical notes to the quotations, Mr Torday places the data in the right perspective, correlates the observations of the various authors, and establishes the functional aspect of the material at his disposal But it seems necessary once more to urge the Trustees, who, I know, are fully aware of the inadequacies of the present plan, that energetic steps should be taken to a complete revision of the bequest

As it stands, the book is a most tantalising production The field-worker, the administrator, the missionary, and even the traveller could use [illegible] with the greatest profit on the spot in Africa But how is he to carry a volume 1½ ft by 1 ft and some twelve pounds in weight unless a special means of

transport and a scaffolding or lectern be provided to read it? It would be necessary in the wilds of Africa to charter an elephant, a camel, or at least an ass or a Ford lorry in order to make it the 'handy guide-book of Africa', to which title it has full claim Had it been published in a portable size, and had it been allowed to Mr Torday to divide the material geographically, this book might have consisted of several volumes, each relevant to one particular area, each portable, and the whole of the greatest practical utility Again, it is a thousand pities that a writer of Mr Torday's eminence should be compelled to make a mere compilation with comments and cross-references only, and limit his original contribution to an all too short preface This, written with the weight, attractiveness, and convincing clarity for which Mr Torday is well known, among others through his "Causeries Congolaises", contains a brief exposition of the functional point of view, illuminating sidelines on the nature of African races, especially of the Hamites, Pygmies, and the Bantu, and it gives us also a summary of the enormous advances attained by African studies since 1875, when the first version of "African Races" had been contributed as a volume of Herbert Spencer's "Descriptive Sociology"

The excellent map contributed by Miss Ursula Torday will be a boon, not only in the use of this volume, but also for African anthropology in general B MALINOWSKI

Conduction in Electrolytes

(1) *Electrolytic Conduction* By Prof F H Newman Pp xii+441 (London Chapman and Hall, Ltd, 1930) 25s net

(2) *The Electrochemistry of Solutions* By Dr S Glasstone Pp x+476 (London Methuen and Co, Ltd, 1930) 21s net

THE study of physical science is extraordinarily fascinating nowadays We see much farther, even if we see a little less clearly than our grandparents saw—or thought that they saw Our most innocent experiments and observations are weighted with philosophical and theological implications of cosmic importance We make measurements that are each year more and more exact, and find ourselves committed to a principle of indeterminacy We read of a quantum mechanics which, in a praiseworthy endeavour to escape from those mechanical pictures which are based on an extrapolation of our large-scale experiences, employs a symbolism in which the exact nature of the symbols employed remains unspecified *Naturam expellas furca* , and the heroic exponents of these latest symbolic methods—latest, though not novel, for are they not closely related to the ideals of Kirchhoff?—find themselves compelled, willy-nilly, to use terms and concepts based on those of our everyday experience

It is all very interesting, but it is none the less pleasant to find that there are corners in the realm of science where a consistent scheme can be built up on a basis of 'ordinary' space-time perceptions, where the principle of indeterminacy is not, where the motion of ions through a viscous fluid is determined (perhaps a little doubtfully) by Stokes's law, and where a modern theory of strong electrolytes may be based on nothing more unusual than Boltzmann's principle and Poisson's equation The theory of electrolytic conduction and the technique of the measurements associated therewith are in a state sufficiently stable to make it worth while to attempt an assessment of the condition of this important branch of physical science, and the two volumes here reviewed cover the topics of greatest importance in a very comprehensive and systematic manner

(1) Prof Newman's book is written by a teacher who has a lively and sympathetic appreciation of the difficulties which confront an intelligent and conscientious reader The work, which will provide stimulating reading for a university student of honours grade, builds up the subject from the very elements In a laudable desire to give the reader all that he needs between the covers of a single volume, the author leads off with a condensed but very clear sketch of thermodynamic principles, which includes a discussion of the usual relations between osmotic pressure and boiling or freezing points, of thermodynamic potential and free energy, of the Nernst heat theorem, the phase rule, and the Gibbs adsorption equation Condensation has its dangers, however, and, admirable though the summary is, we confess to a dislike of the dictum that $\Sigma\,(dQ/T) < 0$ for an irreversible cycle, while the unadorned statement that, if δQ is the amount of heat passing (by conduction) from a body at a temperature T_1 to a body at a temperature T_2, then the net gain of entropy is $(\delta Q/T_2) - (\delta Q/T_1)$, raises more doubts than it resolves

The main body of the book covers a wide field Starting from the fundamental Arrhenius concept of spontaneous dissociation, the author develops a general view of the problem of electrolytic conductance, and then proceeds to treat in detail of ionic migration, ionic equilibria, cells and electro-

motive force, electro capillarity, polarisation, the measurement of electrolytic resistance, theories of electrolytic solution, and technical applications A reasonably full bibliography accompanies each chapter, and a reader who has used the book intelligently will find its perusal a very useful preparation for an attack on research problems in electrolysis

It has been the reviewer's experience that one branch of experimental work, and that branch one of fundamental importance, has been shrouded in a quite unnecessary mystery We refer to the measurement of electrolytic resistance, where it is not uncommon to find an experimenter capable of, and actually making, very precise determinations with but a cloudy idea of the exact conditions under which inductance and capacity effects are balanced out, and of the relation between impedance and resistance Prof Newman's chapter on electrolytic resistance measurement, wherein he discusses very clearly and straightforwardly the application of the ordinary alternating current equations to the bridge system involved, should do useful service in dispelling this mystery His descriptions and diagrams of the experimental methods used, including that of a valve oscillator as a source of alternating current, are clear and up to date But we note that he begins the chapter with the remark that "as shown by Kohlrausch

$$E_0 \sin pt = Ri + P\int i dt",$$

developing the theory from this equation Prof Newman has been so thorough, within the limits of his four hundred and forty pages, in his treatment of fundamentals that it seems a pity that he should pass over this important expression without more detailed discussion, and we trust that in a later edition of his work he will remedy this omission

The chapter on theories of electrolysis gives a very useful resumé of the various theories of strong and of weak electrolytes, and the exposition of the Debye Hückel theory and of the subsequent developments by Onsager is very clearly put

(2) The bias of Dr Glasstone's treatise is indicated by its title being, as compared with Prof Newman's book, considerably fuller in its discussion of those topics which are usually associated with an advanced course of physical chemistry He, again, starts from the fundamentals, and while his discussion of the methods and theory of resistance measurements is a little more restricted than that of Prof Newman, he gives us a more detailed treatment of topics such as overvoltage, depolarisation, the theory of amphoteric electrolytes, and the theory of reversible cells, which last topic is treated in very considerable detail

In discussing the elementary theory of ionic migration and concentration changes, Dr Glasstone makes use of the usual picture of chains of oppositely moving positive and negative ions, it would add much to the interest of his treatment were he to give some reference to the critical paper dealing with this method of illustrating the process which was read by Prof S W J Smith some years ago before the Physical Society (*Proceedings of the Physical Society*, **28**, 148, 1916) Neither book contains a reference to the simple and elegant algebraic treatment of this problem which was advanced by Larmor in his Adams prize essay on "Æther and Matter" (p 289, Appendix C, on Electrolysis)

The choice of topics lies entirely within the author's province, but the reviewer feels that it would add considerably to the value of an interesting treatise were Dr Glasstone to consider in some little detail Smith's very interesting experiments on the potential difference developed at the interface between two electrolytic solutions, and on the related problems of the asymmetric nature of the surface tension potential curve for a capillary electrometer

The two books are in some measure complementary and, taken together, give a conspectus of results and theories in this department of physical science which will be invaluable to physicists and to physical chemists, and will provide the research student with a mine of indispensable information

ALLAN FERGUSON

The Passing of Woad

The Woad Plant and its Dye By the late Dr Jamieson B Hurry Pp xxviii + 328 + 17 plates (London Oxford University Press, 1930) 21s net

BRITAIN has always been fortunate in its amateur scientific workers men, by no means real amateurs in science, who find delight in the intervals of a busy life in following seriously some definite line of investigation Of this category was the late Dr Hurry, who, in the midst of a very crowded career as a medical practitioner in Reading, was yet able to study systematically and as a most careful monographer to render signal service to knowledge Quite why he chose to tell the story of the woad plant is not revealed, but he had a lifelong interest in economic botany and at his home he established an educational garden and

museum The woad plant and its famous blue dye are studied from an international point of view, and the book aims both at giving a comprehensive account of the industry in several countries and emphasising so many other points of view that it becomes a contribution to our knowledge of the social and industrial life of the Middle Ages

Successive chapters deal with the cultivation and manufacture of woad, its use in the fermentation vat, the extraction of the glucoside, indican, succeeded by an historical account of the industry in Britain, France, Germany, and Italy Economic questions have next place, followed by a full account of the old world lore relating to the place of woad in herbals and in therapeutics Final sections are devoted to the protection by legislation and the death of the woad industry

Dr Hurry's name is a sufficient guarantee of the thoroughness and careful attention to detail which characterise the book, withal it is attractive reading for those who appreciate broad and liberal treatment of what might appear to be a specialist subject There have been two crises in the woad industry The first was when in the seventeenth century trade routes were opened up to India and the dye, extracted from material made in Europe, was threatened by imports from that country The Dutch East India Company, formed in 1631, in course of time imported sufficient indigo into Holland to supply the needs of the whole world At much the same time, logwood and Brazil wood also appeared on the scene, so there is little wonder a strenuous campaign took place to secure protective legislation in favour of the indigenous dye, the woad merchants were so successful as to induce various governments to prohibit entirely the use of exotic indigo Even the death penalty threatened those who infringed the protective laws then passed As is well known, protection failed, the superiority and the cheapness of exotic indigo could not be gainsaid In Germany, too, the Thirty Years' War destroyed the woad fields and the villages of Thuringia

The second crisis was due to the advance of synthetical organic chemistry Synthetic indigo was first made in the laboratory, starting out from aniline, and then after some years of persistent effort, at the time regarded as a model piece of industrial research, and the expenditure of very large sums of money its economical industrial production was achieved shortly before 1900 A fierce struggle between the natural and the artificial product ensued, fought with the utmost energy and often bitterness on both sides Indigo planting in India became no longer profitable, and though scientific methods were introduced, yields increased, costs reduced, the natural indigo could scarcely hold its own With the advent of the World War, first England and then the United States became makers of synthetic indigo, and at its conclusion joined battle with Germany primarily to secure the Chinese market Costs were drastically and suddenly reduced so that the natural product received its death blow overnight To day indigo is cheap enough, but it is doubtful if the makers profit the gain goes to the Chinese

The economic history of woad is matched in interest by its botanical and by its chemical significance and by the legends which surround it The chemist has synthesised in his laboratory both indigo the dye, indican the glucoside, and also bromoindigo and its glucoside "the purple of the ancients", the Tyrian purple of the Roman emperors, who obtained it from the tongue of a deep water mollusc Indigo was first brought to Rome about A D 50, so that the purple is of older date than the blue

The carpets at the Persian Exhibition in London have taught us anew of the wonderful and permanent colours obtained from plants—woad, madder, Persian berries, and many others should be grown at Kew and elsewhere suitably labelled to remind us of the contents of Nature's paint-box

E F ARMSTRONG

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Das Tierreich eine Zusammenstellung und Kennzeichnung der rezenten Tierformen Gegründet von der Deutschen Zoologischen Gesellschaft Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin Lief 52 *Myriapoda* 1 *Geophilomorpha* Bearbeitet von Dr Graf Attems Pp xxiii + 388 60 gold marks Lief 53 *Crustacea Copepoda* 2 *Cyclopoida Gnathostoma* Bearbeitet von F Kiefer Pp xvi + 102 n p (Berlin und Leipzig Walter de Gruyter und Co, 1929)

Two further parts of this great work have recently appeared, in each of which the literature of the respective subjects up to the beginning of 1929 has been considered

(1) Dr Graf Attems prefaces the systematic part of his volume by an account of the external features of the Chilopoda and of the epidermis and its glands, including the unicellular ventral glands of the Geophilids, each cell of which is enveloped by a network of striated muscle fibrils There is a brief reference to the sense organs The characters of the order Geophilomorpha are stated, the features of systematic importance are described, and a table is given for the separation of the ten families The

subsequent treatment follows the usual lines, with which those who have used the previous parts are familiar—a definition of each family, a key to its genera, a definition of each genus, and keys for the constituent species and subspecies 128 recognised genera and 452 species are described, but there remain 17 genera and 190 species the position of which is uncertain, owing to insufficient diagnosis by their respective authors An appendix is devoted to an account of about a score of species, for the most part described after the preparation of the body of the work

(2) The first suborder of the Copepoda—the Calanoida—formed the subject of the sixth volume (1898) of this work The present author briefly states the characters of the second suborder, the Cyclopoida, and its three sections, the Gnathostoma, Siphonostoma, and Pœcilostoma The first of these sections forms the subject of this part Three families with 18 genera and 192 definite species are considered About 50 additional species are of uncertain position The author appears to have overlooked two new species of *Cyclops* described by G S Brady in 1910 This part will be of use not only to marine and freshwater zoologists, but also to helminthologists who desire to determine the species of *Cyclops* which they find acting as intermediate hosts—for example, for the broad tape worm of man and for the guinea-worm

Each part has a systematic index and *nomenclator generum et subgenerum*

A Newton among Poets Shelley's Use of Science in Prometheus Unbound By Prof Carl Garbo Pp xiv + 208 (Chapel Hill, N C University of North Carolina Press, London Oxford University Press, 1930) 13s 6d net

THIS valuable and interesting book is another proof of the breadth of mind with which American professors so often pursue their studies The bulk of the book is taken up by a summary of the scientific theories of Shelley's time, and especially of the work of Humphry Davy and the poems of Erasmus Darwin which had appeared just before Shelley wrote his "Queen Mab" and "Prometheus Unbound" The result of applying these to the elucidation of the poems, and especially of the "Prometheus", is highly curious and instructive It was well known before that Shelley was passionately interested in science and fond of experiments in chemistry and electricity His father is reported to have once returned a book on chemistry which Percy had borrowed, because it was "a forbidden thing at Eton", and Prof Whitehead, in "Science and the Modern World", quotes a notable example of Shelley's power of visualising an astronomical relation But no one before Prof Garbo has gone through the "Prometheus" thoroughly with this thought in mind, and his conclusions generally command assent It is obvious that Shelley's mind was steeped with the science of the time, and many of the most beautiful and transcendent passages are chemical or electrical experiments transfigured by poetic genius One might almost think that Shelley was consciously trying to carry out the ideal of the poet of the future which Wordsworth sketches in the famous preface to the second edition of the "Lyrical Ballads" (1800) "The remotest discoveries of the Chemist, the Botanist or Mineralogist will be as proper objects of the poet's art as any upon which it can be employed And what is now called science, thus familiarised to men, shall put on, as it were, a form of flesh and blood, the Poet lending his divine spirit to aid the transformation" We commend a consideration of this further connexion to Prof Garbo for his second edition F S M

Life and Evolution an Introduction to General Biology By Prof S J Holmes Pp v + 449 (London A and C Black, Ltd, 1931) 12s 6d net

AN elementary text book of biology, written by the professor of zoology in the University of California, and designed, not so much to prepare students for further specialisation in a branch of biology, as to give a general view of biological problems to those whose main energies are going to be directed in other fields The book is comprehensive in scope, ranging from protoplasm and the cell theory, through the different forms of plant and animal life, to heredity, evolution, and eugenics

Prof Holmes's book was originally published in the United States, and that edition was reviewed in NATURE of June 5, 1926 For the British edition, now before us, a number of minor revisions have been made in the text, and about twenty of the illustrations have been changed or improved The most important revision, however, is the anglicising of the spelling throughout and the complete remodelling of the bibliography at the end of each chapter for the benefit of British readers Otherwise the book is identical with that already published in America

Air Ministry Meteorological Office The Meteorological Glossary (M O 225II) Second edition, entirely rewritten In continuation of *The Weather Map* Published by the Authority of the Meteorological Committee Pp 233 + 12 plates (London H M Stationery Office, 1930) 4s 6d net

THIS glossary shows signs of very thorough revision and is full of information in a compact and handy form, thereby fulfiling some of the functions of a text book There are charts and numerous diagrams, and a good deal of statistical and descriptive information about the climate of Great Britain is given under several of the headings, particularly in the section on rainfall It is difficult to think of any term in any way connected with meteorology that is not given a place in the bold type headings, and the names equivalent to the English of a number of meteorological phenomena are given at the end of the volume in several languages, at the request of the International Meteorological Committee References in the articles to matters dealt with in other parts of the glossary conveniently appear in italics

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Stellar Structure

ZANSTRA'S recent determination of the temperatures of the *O* stars in planetary nebulæ [1] makes it appear extremely likely that these stars are all generically in the 'white dwarf' class, with mean densities far above anything known on the earth. He has found temperatures between 30,000° and 100,000° for about twenty of these objects, and yet their luminosities are comparatively small. For a fairly typical nebular nucleus we may assume a photographic magnitude of 12.5 with a parallax of 0.002″, making the absolute magnitude +4, or about eight magnitudes fainter than typical galactic *O* stars. It is, of course, true that the luminous *efficiency* falls off with rising temperature in this range, but an increase in temperature at constant radius must always involve an increase in brightness, proportional, even in the farthest part of the Rayleigh–Jeans region, to at least the first power of the temperature. Thus these stars must be of very small radius.

Zanstra obtains his figures from the difference between the measured brightness of the star and that of the nebula, which latter is assumed to be excited by the main (Schumann region) radiation of the star, and to convert all of it to long wave-lengths. The nebula thus performs the correction from visual to bolometric magnitude for us, as it were; if it does not do so completely, the star must be still hotter than is calculated. The correction is found to vary between 2 and 7 or 7.5 magnitudes; in an average case it would be about 5 magnitudes, and the temperature would be rather more than 55,000°. Such a star would then be about 5.9 magnitudes brighter than the sun bolometrically, with ten times its surface temperature; this means a radius 1/43 of the sun's, so that even with the sun's mass its density would be more than 100,000 gm./c.c.

The masses are, however, certainly greater. In a typical planetary, the line of sight rotational velocity can be taken as 5 km./sec. at 6″ from the nucleus, and with a parallax of 0.002″ this gives a mass 80 times the sun's.[2] If the gas is partly supported by radiation pressure, or if the axis is inclined to the line of sight, the figure comes out even greater. This may be set off against the allowance for the mass of the nebular envelope. The data indicate, therefore, a mean density of 10^6 or 10^7 gm./c.c., which is greater than has even been suggested for any other bodies, and points conclusively to a degenerate state of matter.

These bodies appear to be at the upper end of a sequence of 'white' dwarfs, as may be seen from the following summary:

	M_v	Spectrum
Planetary nuclei	+4	*O*
o Ceti *B*	6	*B*8e
o^2 Eridani *B*	11	*A*0
Sirius *B*	10	*A*5
van Maanen's star	14.5	*F*
Wolf 489	13	*G*

It looks as if this sequence were roughly parallel to the main sequence, probably separated from it by a sparsely populated band, and with considerable scattering within it; at least, the general trend is evident, and the reason why no red stars of the 'collapsed' type have been discovered is of course obvious.

There are grave difficulties in the assumption that the source of energy within these white dwarfs is of the same nature as that within giants and main sequence stars, so that it seems worth while to point out that they have no very obvious need for a subatomic source at all. Just before degeneracy sets in, the internal temperatures must be of the order of at least 50 times those of a main sequence star built on the 'diffuse' model, or fully 10^9 degrees; Milne's calculation for the companion of Sirius [3] indicates a central temperature not exceeding (but apparently approaching) 3×10^9 degrees. The rate of radiation of such a star is only about 1/100 of that of the sun, or say one calorie per gram in 60 years; taking the specific heat as 3 (when the gas is still on the edge of degeneracy) we see that there is an internal store of heat sufficient for radiation at the white dwarf rate for something of the order of 10^{11} years. Of course, the very fact that the star is about to become degenerate means that not nearly all the kinetic energy of the nuclei and electrons will actually be available for radiation; much of it must remain as zero point energy permanently in the star. But against this we must set the further energy to be obtained from such contraction as is still possible; at these small radii this energy is large. On the whole, then, the life of a white dwarf comes out, without any subatomic sources, entirely comparable with that of any star that derives its energy from the transmutation of hydrogen into heavier elements.

If the available subatomic energy of a main sequence star is exhaustible, the period spent in the main sequence will be followed by one of gravitational contraction; in the early stages this will be rapid, because the radius is large, and because at least half the energy gained will go into heating the interior of the star; in the late stages, the internal temperature will actually be falling, gravitational contraction will be very effective (if degeneracy is not too marked) and the rate of radiation will have become small. The fairly late stages will therefore be passed through very much more slowly than the early ones, and there will be a marked statistical concentration of the stars at radii perhaps two or three times the minimum figures calculated by Milne for a fully degenerate star. The minimum values are roughly $M^{-1/3}/80$ times the sun's radius, for a star of mass M times that of the sun, and where the masses are known the radii are all of about the anticipated size. Particularly high densities are clearly to be expected for the *O* stars. In van Maanen's star, with a radius of 0.007 times the sun, it is tempting to suppose we have a massive star in a very late stage indeed; if Milne's formula is applicable, the mass must be at least 8 times the sun, which would mean an Einstein shift corresponding to at least 700 km./sec. This could easily be tested by observation.

It is worth remarking that in a century or less the true radial velocity of a star of such large proper motion and parallax as this could be found from the second order term in the proper motion; the relativity effect, even if much smaller than 700 km./sec., could then be fairly definitely determined.

However that may be, we have now fairly good evidence that stars of all masses can 'die'; this does not prove that transmutation rather than annihilation of matter is the source of stellar energy, but it clearly favours it. For Milne's theory leads to the conclusion that a mainly or nearly degenerate star will have a central temperature that may be much less than, but cannot be greater than $3.9 \times 10^9 M^{5/6}$, and this seems inadequate to stimulate a source of energy that was

not active in the main sequence, especially if all stars have dense hot cores, as Milne believes. Thus the very latest stages of degeneracy, where the specific heat is small and contraction difficult, must be run through rapidly, and the total duration of the white dwarf stage probably is not much greater than we have already calculated. The probable relative abundance of white dwarfs is then somewhat difficult to reconcile with a time scale of 10^{13} or 10^{14} years, but fits well with the transmutation theory time scale.

The view that the nuclei of planetary nebulæ are 'white dwarfs' has, we now find, already been propounded by Jeans in "The Universe Around Us", pp. 309-311. That we had both failed to notice this can be excused, if at all, only by the great popularity of the publication in which the theory was announced, but we sincerely regret the oversight. In the application of this result we differ from Jeans, since he tentatively placed these stars at the beginning of stellar evolution, while we place them, with the other white dwarfs, at the end.

H. N. RUSSELL.

Princeton University.

R. D'E. ATKINSON.

Rutgers University,
Mar. 31.

[1] *Zeit. f. Astrophysik*, **2**, p. 1; 1931.
[2] Cf. Russell, Dugan, and Stewart, "Astronomy", p. 83.
[3] *Mon. Not. R.A.S.*, **91**, p. 39; 1930.

Emission Bands in the Mercury Spectrum under Low Excitation

SOME years ago I found a long series of diffuse bands from λ2943 to λ2614 in the absorption spectrum of a long column of mercury vapour.[1] The same series was found independently and about the same time by Mohler and Moore.

Up to the present, these bands have never been obtained in emission. I now find that when mercury vapour is fluorescing under the iron arc (excitation from λ2650 to λ2537) these bands are emitted, and in much greater intensity if the vapour is superheated. The continuous emission from about λ2950 to λ3600 (maximum at λ3300) is also much increased by superheating, while the green visual fluorescence is extinguished. So far as my experiments go, the emission bands seem to be in close relation to this continuous emission at λ3300, though I am not prepared at present to say that this is invariably the case. Much longer exposures are required for the bands than for λ3300, but when such exposures are given, the bands appear as a kind of prolongation of the continuous emission. The continuous region, it is to be noted, is at the less refrangible end of the band series, where the band spacing is widest, and not beyond the convergence point, and this continuous region, unlike the bands, is not known in absorption. It will be important to examine the absorption of the superheated vapour.

The remarkable phenomena connected with the band spectra of mercury, and the long time of duration of the emission, are very complicated, and I think that speculation has rather outrun our knowledge of the facts, which is by no means adequate. It is my aim to find out as much as possible under conditions of low frequency excitation, less than the frequency of the atomic resonance line λ2537. These conditions should reduce the problem to its simplest form.

RAYLEIGH.

Terling Place, Chelmsford,
April 20.

[1] *Proc. Roy. Soc.*, A, vol. 116, p. 705; 1927.

Proton and Electron

THE ratio of the mass of the proton, M_P, to that of the electron, m_e, is a pure number which is likely to be of considerable importance in physical theory. In a recent letter, Dr. W. N. Bond[1] has deduced for this ratio the value $1846 \cdot 5_7 \pm 0 \cdot 4_8$ with a probable error which should be accurate to about ten per cent. This is very close to the 'deflection' value of Birge,[2] $1846 \cdot 61 \pm 2$, but larger than the 'spectroscopic' value $1838 \cdot 26 \pm 1$.

The suggestion of A. P. Mathews that

$$\frac{M_P}{m_e} = \left(\frac{135}{\pi}\right)^2 = 1846 \cdot 58$$

gives remarkable numerical concordance with Bond's estimate, but it seems, at present, to have no theoretical significance.

As Dr. Bond has pointed out, the relation proposed by Rojansky[3] and also by Eddington,[4] which gives

$$\frac{M_P}{m_e} = \frac{(136)^2}{10} = 1849 \cdot 6,$$

is not in good agreement with recent experimental determinations.

The same objection applies to Witmer's hypothesis[5] that

$$\frac{M_P}{m_e} = (43)^2 = 1849.$$

I venture to add one more suggestion to the many already made as to the ratio of these two masses. Fürth[6] has obtained a remarkable relation involving the constant of gravitation, G, and the mass of the 'neutron' which he regards as formed by the combination of a positive and negative electron. Assuming this mass to be the same as that of the hydrogen atom, M_H, his relation may be written in the simplified form $2\hbar c/GM_H^2 = (16)^{32}$, where $\hbar = h/2\pi$. This gives good agreement with experimental results.

The power of 16 which occurs in Fürth's relation is introduced in considering the number of arrangements in a 16-dimensional continuum as in Eddington's theory, which requires 16 parameters for the complete determination of an electron. For an electron Fürth finds a total of 16^{16} possible arrangements and for a 'neutron' 16^{32} distinct possibilities. His formula suggested to me that the ratio of the masses of proton and electron might be of the form

$$\frac{M_P}{m_e} = \left(\frac{16}{10}\right)^{16} = 1844 \cdot 68.$$

Here again, the number 16 represents the number of parameters or 'degrees of freedom' which, according to Proca,[7] are characteristic of an electron. These Proca classifies as 4 co-ordinates, 4 moments, 3 components of magnetic moment, 3 components of electric moment, the mass, and the de Broglie wave-length. The presence of the integer 10 in the above relation may be explained by assuming that, of the 16 degrees of freedom associated with an electron, 6 are suppressed or 'frozen' in the case of the positive electron. It is natural to suppose that these are the three components of the electric moment and the three components of the magnetic moment, all of which are here regarded as having some real physical meaning for the negative electron. Perhaps the proton, as contrasted with the negative electron, is simply 'a hole in the ether' without electric or magnetic moment. This hypothesis reverses the rôles assigned to these two entities in 1913 by S. B. McLaren, who assumed that the positive electron was the magneton.

It is with some hesitation that I put forward this tentative suggestion, partly because the theory of

Furth seems to be based on somewhat uncertain assumptions, and also because the value suggested for the ratio of the masses is not in exact agreement with either the 'deflection' or the 'spectroscopic' values

H S Allen

The University, St Andrews,
April 11

[1] W N Bond Nature 127, p 164 and p 557 1931
[2] Birge *Phys Rev* Supplement vol 1 No 1 pp 1 73 1929
[3] Rojansky Nature 123, p 911 1929
[4] Eddington, Nature, 126 p 942, 1930
[5] Witmer, Nature 124 p 180 1929
[6] Fürth, *Phys Zeitsch*, vol 30 p 895 1929
[7] Proca, *Journal de Physique*, p 235, July 1930

Low Altitude Aurora

Mr Axel Corlin[1] has described an observation which has convinced him that the aurora can appear under the clouds I have also observed a similar phenomenon, but in circumstances which made it possible for me to convince myself that the whole effect was an illusion and that the aurora was above and not below the clouds

In my opinion it would be unfortunate if Mr Corlin's account should be accepted as good evidence that an aurora can appear 'only a few thousand metres above the ground' especially in view of Prof Chapman's important article[2] in which he practically accepts the evidence for low aurora

The essentials of Mr Corlin's account are as follows

"In the afternoon of Nov 16 1929 during my stay in Abisko in northern Sweden (N lat 68 21′) I observed a rather intensive auroral ray of about 10° apparent length and about ½ apparent breadth in the west south west *below a completely cloudy sky*"

"The clouds, apparently situated behind the ray, were of stratiform alto cumulus type and consisted of apparently thin and thick strata The ray began in or in front of a thin stratum, crossed over a thick (more dark) stratum *without appearing less intense here* and vanished in or in front of the next thin stratum In the east, similar clouds covered almost completely the sky and *also the full moon* which was visible only a few times between the clouds Examining carefully the facts mentioned above in italics, I could not escape the conclusion that the auroral ray must be *below the clouds*, that is at only a few thousand metres above the ground"

My experience is recorded in a paper, "Atmospheric Electricity in High Latitudes",[3] which describes observations made at Karasjok, Norway (69 17′ N, 25° 35′ E), during twelve months, October 1903–September 1904 I wrote, p 92

"It has long been a matter of controversy as to whether the aurora ever extends into the lower regions of the atmosphere Several observers positively affirm that they have seen it quite close to the ground This may be due to an optical illusion, one evening I was, for a considerable time, in doubt as to whether the aurora was really under the clouds or not All over the sky were detached clouds, the clouds and spaces between them being of about the same size and shape Right across the sky a long narrow aurora beam stretched, showing bright and dark patches owing to the clouds It looked exactly as if the aurora beam ran along under the clouds, brightly illuminating the patches of cloud which it met In reality the bright patches were the openings and not the clouds It took me a long time to make quite certain of this, and it was only by at last seeing a star in the middle of a bright patch that I could be quite certain"

It is clear that these two experiences were practically identical, and there can be little doubt that what Mr Corlin considered to be thicker parts in the cloud covering were really breaks in the cloud through which the dark sky could be seen In his case the illusion was probably enhanced by the clouds near the moon showing dark centres

Although it is now twenty seven years since I made my observations, I clearly recollect the difficulty I had in deciding what was cloud and what was clear sky The illusion was most convincing, and if I had not been able to see the stars in the patches which appeared to me to be illuminated cloud I should have come to the same conclusion as Mr Corlin

G C Simpson

Meteorological Office, London
April 15

[1] Nature April 11 p 553
[2] Nature Mar 7 p 341
[3] *Phil Trans Roy Soc* A vol 205 pp 61 97 1905

The Molecular Weights of Proteins

One of the most satisfactory features of recent advances in the X ray analysis of compounds of high molecular weight has been the degree of co ordination between the efforts of the structure analyst and those of the chemist Especially is this true in the case of investigations of the structure of cellulose and its derivatives The question of protein structure, however appears to bring in its train problems of quite another order of complexity, and it does not seem to be at all clear what is connoted by the phrase 'molecular weights of proteins' Such X ray photographs of fibrous proteins as have been obtained point to the periodic repetition of comparatively simple units with imperfect or variable side linkages In the quest for chemical data to correlate with these results the crystallographer is at once brought up against the remarkable observations of Svedberg, that there are groups of soluble proteins of 'molecular weights' which are simple multiples of 34,500 The present situation is most simply described by quotations from two recent letters[1 2] to Nature

1 "The two most striking demonstrations in recent years of such uniformity are afforded by Svedberg's brilliant application of the ultracentrifuge to determine the particle mass of soluble proteins, classes of 'molecular weight' 1, 2 3, and 6 times the common factor 34,500 being distinguished, and Gorter and Grendel's demonstration that under appropriate conditions soluble proteins exhibit the phenomenon of surface spreading on liquids and that all occupy the same surface area irrespective of particle mass (1 2, 3, or 6 times 34,500) Using Svedberg's common factor 34 500 for the basis of their calculations, the Dutch workers obtain a value for the radius of the unit particle (22 5 A) identical with that determined by Svedberg experimentally"

2 "Three determinations of the sedimentation equilibrium of insulin at a pH of 6 7–6 8 gave as a mean value for the molecular weight 35 100, which within the limits of experimental error is the same as that for egg albumin, 34,500, and for Bence Jones protein, 35,000 The sedimentation equilibrium determinations show that crystalline insulin is homogeneous with regard to molecular weight, that is, the molecules in the sample studied were all of the same weight"

If now we consider this problem from the purely crystallographic point of view—and it has been demonstrated that proteins under certain conditions can give rise to X ray crystal photographs—the numbers 1, 2, 3, and 6 immediately invite attention as being possible numbers of 'molecules' which can go to form a unit of pattern The suggestion thus

arises that, provided we can explain the occurrence of the weight 34,500, the rest may be merely another aspect of that grouping of molecules which is called crystalline But if this is so, we have to account for the non occurrence of the number 4, and the explanation of this gap must be given in terms of some outstanding characteristic of proteins in general

In order to explain the sequence of numbers observed it does not seem necessary to invoke anything more unfamiliar than the ordinary peptide chain, CO NH CHR CO NH CHR , which is built up of a succession of triads of which the CO and NH groups are unsaturated , for if we postulate that the CO and NH groups of neighbouring chains can be linked together by secondary valences, the following simple crystallographic combinations[3] are at once available (Figs 1*a*, 1*b*, 1*c*, 1*d*)

In Fig 1*b*, corresponding to the crystallographic space group C_2^1, the unit of pattern is a pair of chains pointing in opposite directions while the basis of Fig 1*c*, space group C_3^2, is a self contained threefold screw of chains all pointing in the same direction In Fig 1*d* one of the chains has been omitted to avoid confusion, but it will be seen that it is a grouping

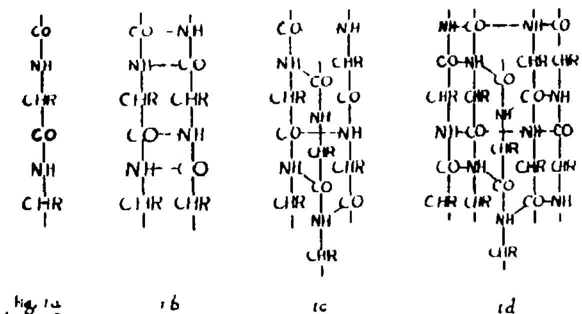

FIG 1

which is a combination of (*b*) and (*c*) based on the space groups D_3^6 and D_3^4, and is also a self contained threefold screw, but this time not of single chains, but of pairs of chains such as are shown in Fig 1*b* All these molecular associations are well defined crystallographic types -the arrangement shown in Fig 1*d*, for example corresponds to the structure of such a common crystal as quartz —which might be expected to undergo reversible dissociation into their constituent units, or sub groups That such a process actually does take place is best illustrated by the words[4] of Svedberg himself —"The protein molecules containing more than one group of weight 34,500 are, as a rule, dissociated into molecules of lower numbers of groups of 34,500 when the *p*H of the solution is raised over a certain value Thus the proteins of weight (6 × 34,500) split up into molecules of 1/2, 1/3, and 1/6 of the original molecule, but never into molecules of 1/4 or 1/5 of the original This is in line with the fact that proteins possessing these latter weights at or near their isoelectric point have not been met with At sufficiently high alkalinity all proteins have the same molecular weight, viz , 34,500 "

The problem embodied in the last sentence still remains for discussion, and we should like to suggest as the interpretation of this, the most fundamental difficulty of all, that the observed constancy of unit molecular weight is simply a case of the vibrational instability of peptide chains when their length exceeds a certain value If we accept the X-ray indications that the fibrous proteins, such as hair[5] and silk,[6] are based on the periodic repetition of comparatively simple units, then the probability of disruptive resonance occuring among the constituents of the peptide chain will continually increase with the length, so that excessively long chains would be liable to spontaneous decomposition into shorter chains We may imagine some such process taking place the laboratory of the living cell as the amino-acids ar laid down in long chains at a surface and consolidated by crystallographic groupings in the manner suggested above, or by intra molecular folding such as has been demonstrated in the case of wool and hair[5] From this point of view, it does not seem likely that the unit molecular weight of proteins is strictly constant—this, too is in agreement with experiment- but there is a strong probability that, given the appropriate conditions, many proteins will be based on a roughly constant weight of peptide chain *

A phenomenon which appears to involve analogous reasoning is the decay of tension at constant length which takes place in stretched hair containing moisture, and which has been investigated by Speakman[7] A large part of this loss of tension is quite permanent,[8] in spite of the fact that the stretched hair still retains its power of recovering at least its original length in water The rate of decay of tension varies with the type of wool or hair and with the nature of the wetting agent, and increases with rise of temperature It is extremely rapid in steam, a short treatment with which permanently alters the load/extension curve, and so loosens the internal structure of the fibre that it may be caused to contract to two thirds of its original length[5]

It is clear, of course, that the wetting agent plays an important part in this permanent destruction of internal tension, but it seems not at all unlikely that vibrational instability also is an essential factor in the process After treatment of stretched hair with steam, the longitudinal swelling of the fibre in water is considerably increased, a fact which, taken in conjunction with the observation that X ray photographs of hair which has been held stretched in water for several weeks show a definite fuzziness of the reflections associated with the length of the peptide chains suggests that the average length of the chains is decreased by sustained tension in the presence of water

We have recently commenced an investigation of the influence of radiations, such as ultra violet light and X rays, on the elastic and other properties of animal hairs, so that in this connexion it is convenient to mention here some remarkable observations which we have made on *unstretched* wool exposed for some sixty hours to the full beam of a Shearer X ray tube (copper anticathode) After this treatment the fibres show many of the properties which are characteristic of wool which has been exposed *in the stretched state* to the action of steam For example, they have the property of contracting in steam by as much as 37 per cent below their unstretched length, and their longitudinal swelling in water after steaming is found to be increased from the 1 per cent of normal wool to as much as 10 per cent This seems to be a clear case of the disruptive action of high-energy quanta on the length and cohesion of peptide chains, and must be closely related to the influence of various radiations on biological activity

* If we assume the essential correctness of the structure proposed,[5] we may make an estimate of the length of peptide chain in animal hairs. The average molecular weight of the chief amino-acids in wool (which are present in roughly equal molecular proportions) is about 121, and three amino acids occupy a length of 5 15 A along the fibre axis The length, corresponding to 34,500 is thus about 500 A It is a striking fact that this is approximately the length which is the minimum possible to give the observed X ray diffraction effects[5] That it is also near the actual length is indicated by the fuzziness which appears in X ray photographs of hairs which have developed pronounced permanent decay of tension

These experiments are being continued and will be reported in detail in due course

W T ASTBURY
H J WOODS

Textile Physics Laboratory,
University, Leeds,
Mar 27

[1] C Rimington, NATURE, **127** 440, 1931
[2] T Svedberg, NATURE, **127**, 438, 1931
[3] W T Astbury and K Yardley, *Phil Trans Roy Soc*, A **224** 221, 1924 (See Plate 5 (1) (7) Plate 16 (144) Plate 18 (157 and 158))
[4] T Svedberg, *Trans Faraday Soc* General Discussion on Colloid Science applied to Biology, 741 1930
[5] W T Astbury, *J Soc Chem Ind* **49**, 441, 1930 *J Textile Science* **4** 1, 1931 W T Astbury and H J Woods NATURE **126** 913, 1930 W T Astbury and A Street, *Phil Trans Roy Soc*, A, **230**, 75, 1931
[6] R Brill *Ann Chem*, **434** 204, 1923 K H Meyer and H Mark *Ber*, **61**, 1932 1928 O Kratky *Z phys Chem*, **B5**, 297, 1929
[7] J B Speakman *Proc Roy Soc* B **103**, 377, 1928
[8] J B Speakman *Trans Farad Soc*, **25** 169 1929
[9] J Hengstenberg and H Mark *Zeit f Krist* **69** 271 1928

The *p*H Stability Region of Insoluble Proteins

BY means of the ultracentrifugal method developed in his laboratory, Svedberg[1] has measured the stability of a number of soluble proteins as a function of the *p*H of the environment Each of the monodisperse proteins was found to have a fairly wide *p*H stability region which included the isoelectric point By means of a totally different technique, we have recently been able to show that insoluble proteins, such as wool keratin, are no exception to the above

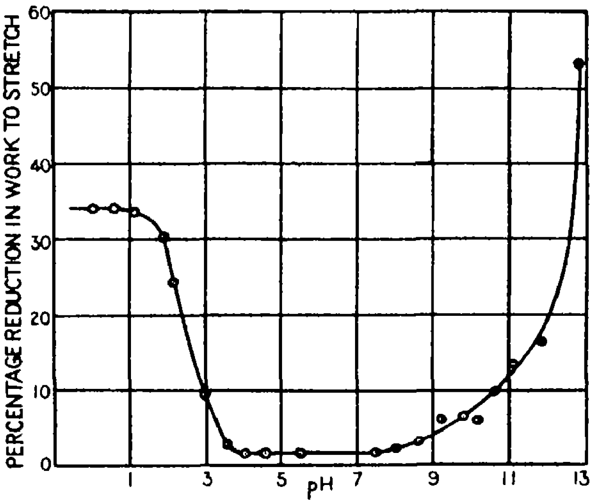

FIG 1

rule The method, which we believe to have a general application, took its origin in the observation that the resistance of wool fibres to extension is far less in acid solution than in distilled water This, and the well known ease of extension of fibres in alkaline solution, give a method for studying the stability of the keratin in various media

Briefly the experimental procedure was as follows the work required to stretch fibres 30 per cent of their length was determined at 22 2° C, first in water at a standard *p*H of about 5 5 and then in the medium under examination, twenty four hours being allowed in each case for the fibres to attain equilibrium Extension was limited to 30 per cent because it has been shown that wool fibres can be extended this amount in distilled water without undergoing significant damage Thus, any difference between the two values for the work required to perform this extension is directly attributable to the different actions of the two media, and it is convenient to express this difference as a percentage of the work required to stretch a fibre 30 per cent of its length in water at the standard *p*H

The results shown in Fig 1 were obtained with sulphuric acid solutions on the acid side of the isoelectric point, and with borax, sodium carbonate, and caustic soda solutions on the alkaline side It is clear that wool keratin is completely stable over a range of *p*H from 4 to at least 7 The isoelectric point of wool, as determined by one of us[2] in 1925, is at *p*H 4 8, and it is interesting to recall that Svedberg[3] states that, for the proteins he examined the isoelectric point "is never situated in the middle of the stability region but is always more or less shifted in the direction of low *p*H values"

The similarity between wool keratin and the proteins studied by Svedberg is not confined to the existence of a stability region and the location of the isoelectric point, but is much more fundamental in character For example, he states that the decomposition of a protein in solutions at a *p*H outside the stability region is in many cases reversible that is, if the mixture is restored to a *p*H situated within the stability region, molecules of the original weight are built out of the fragments Similarly, it has long been known[4] in the case of the wool fibre that the action of $N/100$ sodium carbonate is reversed by the mere removal of the reagent by washing in water More recently the action of acids on wool has also been found to be reversible For example, wool fibres in 4 8 N hydrochloric acid required 39 per cent less work to perform a given extension than in water, but, on washing the fibres free from acid, the resistance to extension reverted almost completely to its original value in water

The complete parallel which thus exists between wool keratin and the proteins studied by Svedberg is important because of certain peculiarities in the action of acids on wool, which have a bearing on his conclusion that the proteins forming one of the two groups defined by him have molecular weights 1, 2, 3, and 6 times 34 500 The action of 98 100 per cent formic acid on wool is instructive In this medium, dry fibres give a load extension curve which is exponential in its initial stages in contradistinction to the normal curve for wool fibres in water, which shows a well defined Hooke's law region up to a stress of 4×10^5 gm/cm^2 Silk filaments in formic acid fail to give an X ray fibre diagram,[5] and a similar observation may be presumed true for wool, suggesting that the long chain protein molecules are freed from their mutual attractions to a very great extent in this reagent Thus the exponential type of load extension curve given by fibres in formic acid would be attributed to the free uncoiling of the molecules in the manner suggested by Astbury,[6] and calculation from the curve shows that the limiting extension to be expected by this process is 28 4 per cent, in close agreement with the value previously deduced[4] from the load extension curve for wool fibres in water and that found by Astbury[6] from X ray studies of stretched wool (about 30 per cent)

Such close agreement can leave little doubt that in formic acid the individual long chain protein molecules of the micelles are greatly freed from their mutual attractions Since the action of both organic and inorganic acids is to reduce the resistance of fibres to extension, it may be presumed that in all cases their essential function is to free the molecules in this way On this view, however, all acids would be expected to show precisely the same behaviour at comparable concentrations and it is here that difficulty is encountered As shown in Fig 1, the resistance of wool fibres to extension in $N/10$ sulphuric acid solution is 33 per cent less than in water, and since the

corresponding value for 11 N sulphuric acid solution is only 39 per cent (including true chemical damage), it is clear that the truly reversible action of sulphuric acid on wool is complete at about $N/10$ concentration The behaviour of hydrochloric acid is strictly comparable with that of sulphuric acid, but formic acid, on the other hand, gives a reduction in the resistance to extension of about 60 per cent, its action being still almost completely reversible Similarly, the swelling of wool fibres in formic acid is of a different order of magnitude from that in sulphuric acid solutions Thus, although the action of these and other acids is of the same general type, gross differences in the extent of reaction exist

It is here that support is given to, and an explanation of the phenomenon derived from, the theory developed by Astbury in the preceding letter If the wool molecule should exist in the condition of a self contained threefold screw of pairs of chains, it is clear that the simplification of this condition can occur in several ways either by the formation of the crystallographic sub groups— three pairs of chains or two triads of simple chains—or by the formation of individual molecular chains On this view, the different reactivities of formic and sulphuric acids with wool would be attributed to the ability of formic acid to carry the simplification of the structure to the stage of individual chain formation, while with other acids simplification must cease at one or other of the intermediate stages If this hypothesis is true, it is clear that the adsorption of acid by wool will be accompanied by the creation of new surfaces available for adsorption, the nature and extent of these surfaces being determined by the nature of the acid adsorbed On this basis, a convincing explanation of the many anomalies in the adsorption of various acids by wool can be given Indeed, most of the phenomena observed in connexion with the action of acids on wool are difficult of explanation except on some such basis as that given above

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Mar 26

[1] Svedberg "General Discussion on Colloid Science applied to Biology" *Trans Faraday Soc*, p 740, 1930
[2] Speakman, *J Soc Dyers and Colourists*, **25**, 172, 1925
[3] Svedberg loc cit, p 741
[4] Speakman *Proc Roy Soc* **103**, B 380, 1928
[5] Meyer and Mark Der Aufbau der Hochpolymeren Organischen Naturstoffe Leipzig 1930 p 224
[6] Astbury, *Phil Trans*, **230**, A 75 1931

Relation between Charge and Stability of Colloidal Gold

IT is believed by most colloid chemists that the stability of a colloid depends on the charge on its particles, and that the greater the charge the greater the stability The results of coagulation of colloids by electrolytes, as well as the effect of dialysis on the stability of the colloid, have been explained on the basis of the above idea Mukherjee and collaborators,[1] however, working on arsenious sulphide sol, found that the stability of this sol is not so directly related to the charge as it is generally believed to be

It is well known that the charge on colloidal gold and its stability towards electrolytes increase with the progress of dialysis up to a certain stage, after which both charge and stability begin to decrease [2] Simultaneous measurements of charge and stability towards electrolytes with the progress of dialysis have been carried out by us to see if there is any definite relationship between charge and stability of colloidal gold

The gold sol was prepared by Zsigmondy's nucleus method, with slight modifications in details The charge measurements were carried out by Mukherjee's method (loc cit), and the stability towards electrolytes was determined by finding the amount of potassium chloride which would be required to produce a definite blue colour The results are shown graphically in the accompanying graph (Fig 1)

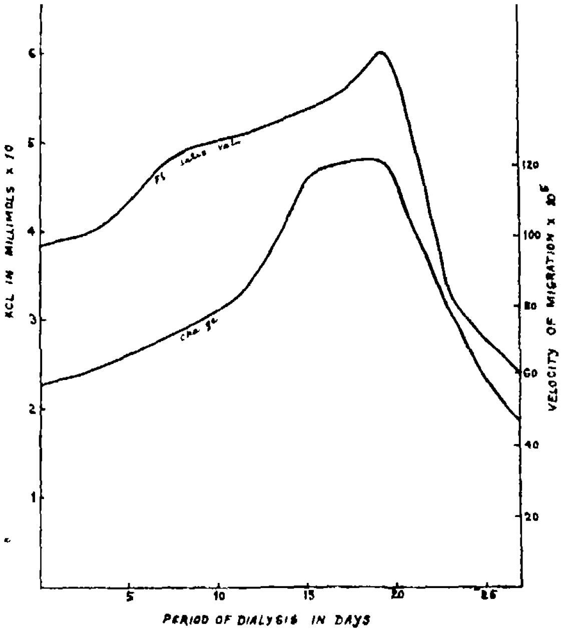

FIG 1

It will be seen from the figure that, with the progress of dialysis, the charge as well as stability increase up to a particular stage (19 days' dialysis), after which both begin to decrease simultaneously We thus find that the stability of the colloid, as determined by its flocculation value, goes hand in hand with the charge on its particles in the case of colloidal gold

The results will be discussed elsewhere in detail A study of other colloids from the same point of view is in progress

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[1] *Jour Indian Chem Soc*, **4**, 493 1927
[2] Freundlich, "Colloid and Capillary Chemistry", 1926, English Translation, p 506

Prof A V Saposhnikoff

THE numerous friends of Prof A V Saposhnikoff will learn with much regret of his arrest and exile (NATURE, April 25) I first came into touch with him during the International Congress of Applied Chemistry in London in 1909, and afterwards had the pleasure of working with him during the War and taking him over several of the explosives factories The last time I saw him was in 1923, when he was in England on business for the Soviet Government He is a charming man, and, under the new régime, was trying to serve his country to the best of his ability and to keep out of politics It is now known that he was arrested on Oct 1, but no charge against him has been made public Knowing him as I do, I can only think that his arrest is the result of some dreadful mistake

Prof A V Saposhnikoff was born on Mar 15, 1868

n Siberia, and received his earlier education with he Corps of Cadets in Omsk and afterwards at he Michael Artillery School and Michael Ordnance Academy in Petrograd He was appointed professor of chemistry at the Michael Ordnance Academy in 1899 and held that post up to his arrest He also held other important posts and was widely consulted and received many honours and decorations, including hat of Knight Commander of the Order of St Michael and St George from Great Britain

Saposhnikoff's work has been varied and is well known to scientific workers in Europe Under the Soviet régime he has carried out much work in con nexion with the use of petroleum on Russian railways, the danger of fire therefrom and means of fighting t, the impregnation of railway sleepers, etc His outstanding researches, however, are on the chemistry of explosives and date from the beginning of the present century up to the War He was not satisfied with the empirical knowledge of the nitration of cellulose and thought that a study of the physico chemical con ditions in the mixed acids used for nitration would hrow some light on the question He therefore measured the vapour tensions of mixtures of sulphuric acid, nitric acid, and water and showed the conditions under which all the water is attached to the sulphuric acid and the nitric acid left free, and also when urther addition of sulphuric acid removed the water from the nitric acid, with formation of nitrogen pentoxide These researches were published in the *Zeitschrift für physikalische Chemie* From this work, he naturally went on to study the relation between the nitrating capacity of mixed acids on cellulose and their vapour tensions The chief results were em bodied in a paper which he read at the International Congress in London in 1909, entitled "La théorie de a nitration de la cellulose" Much fuller details are given in his paper in the *Journal* of the Russian Physical and Chemical Society It also appeared in *Zeit Ang Schiess Spreng* This work has justly been regarded as a most important contribution to the understanding of the nitration of cellulose

Saposhnikoff employed triangular diagrams very effectively to illustrate his results, and examined, in the light of his theory, the data of Vieille, Bruley, and Lunge as well as his own, giving an illuminating explanation of the results obtained Indeed, many of his friends look on him as the 'father' of the theory of nitration of cellulose

It is impossible to refer to all Saposhnikoff's work in this note, although one would like to have dealt with his researches in metallurgy I can, however, emphatically endorse the statement made in NATURE that the loss which the world suffers through the banishment of such a brilliant scientific worker is disastrous

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Phenomena in a Sounding Tube

IN view of Prof Andrade's recent communication on Kundt's tube effects,[1] the following observations may be of interest The experiments were carried out in 1927 but have not yet been published In our case supersonic sound waves were used, and the effects did not differ greatly, contrary to Prof Andrade's suggestion, from those he obtains with waves of audio frequency

A piezoelectric system was used as a source of the supersonic waves, and powerful oscillations of the order of 1 cm wave-length were radiated along the tube The effects of these waves on magnesium oxide smoke were investigated It may be noted at this point that the size of the average smoke particle in the first few seconds of an experiment was of the order of 5×10^{-5} cm radius or less Hence the individual particles would presumably take up the motion of the sound waves rather than act as obstacles like the dust particles in Prof Andrade's experiments

The first observation of interest was that if one end of the tube were open the smoke was pushed out rapidly When, however, the ends were closed, the smoke was observed to circulate in a somewhat irregular manner After a few seconds, large flocculent particles appeared and perfect rings formed on the sides of the glass tube, similar to those obtained with lycopodium in a Kundt's tube, except that they extended right round the tube, becoming a little thinner at the top

The circulation of the smoke was examined more carefully by means of a parallel beam of light from an arc down the centre of the tube At times a more or less turbulent motion occurred throughout the length of the tube, at others there appeared to be formed vortices at distances apart corresponding to the nodes, and at these points large flocculent particles were gradually built up owing to the rapid coagulation of the smoke Some of these large flocks were in rapid rotation about an axis roughly corresponding with that of the tube They remained suspended in the middle of the tube at the nodes so long as the waves continued If the waves were stopped, the flocks rapidly settled after a minute or so, and the tube was found to be practically clear of smoke, nothing but well marked rings remaining

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Mar 23

[1] NATURE Mar 21, p 438

The Nature of Time

IN NATURE of Jan 31, p 163, F O Wollaston and K W Miller suggest that time consists of discrete sections that is, time has an interrupted structure The element of time is assumed to be equal to h/mc^2, where m is the mass of the electron In connexion with this subject, it should be noted that a similar idea was put forward by Robert Lévy,[1] and was afterwards worked out more closely by myself,[2] Gottfried Beck,[3] Wilhelm Anderson,[4] and Seitarô Suzuki [5] In this way it was possible to establish a range of regularities bearing upon astrophysics and the nature of cosmic rays [6] These regularities also correspond well with Dirac's [7] theory of protons and electrons In all these cases, however, it is necessary to take a smaller element of time than that shown above This elementary interval is equal to h/Mc^2, where M is the mass of the proton

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Allunion Electrotechnical Institute,
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[1] Robert Lévy, C R, 183, 1026, 1926
[2] G I Pokrowski *Zeitschr f Phys*, 51, 730 737 1928
[3] Gottfried Beck, *Zeitschr f Phys*, 53, 675, 1929
[4] Wilhelm Anderson, *Zeitschr f Phys*, 55 386, 1929
[5] Seitarô Sûzuki, *Phys Zeitschr*, 31, 619, 1930
[6] E Regener *Naturwiss* 17 183, 1929
[7] G T Pokrowski, *Zeitschr f Phys* 66, 129, 1930

Magnetic Hysteresis on Weber's Theory A Correction

I REGRET a slight oversight in my letter published in NATURE of April 25, p 625 For "*OM*" should be read "*ON*, where *N* is the foot of the perpendicular, Fig 1, from the intersection of *OC* and the unit circle"

W PEDDIE

Dundee.

Ozone in the Upper Atmosphere and its Relation to Meteorology *

By Dr G M B DOBSON, F R S

UNTIL nearly the close of the nineteenth century, meteorologists — with but a few exceptions—had been content to confine their attention to studying the atmosphere near the ground When Teisserenc de Bort and W H Dines began to study the conditions up to a height of 20 km or more by means of small balloons carrying light self recording instruments, it immediately became clear that a knowledge of the free atmosphere is essential to an understanding of the physical processes which we include in the term meteorology Since, however, observations have shown that while pressure gradients associated with cyclones or anticyclones, after continuing without great change throughout the troposphere in most cases, fall off rapidly within the stratosphere, and become very small at about 20 km , we have come to regard the domain of physical meteorology as being roughly confined to that part of the atmosphere below about 20 km I wish now to describe some observations that seem to show that there are effects of cyclones and anticyclones which extend up to something like three times that height

About ten years ago, MM Fabry and Buisson first showed that there is a very small amount of ozone situated at a great height in the atmosphere, and they also developed methods by which the amount could be measured with considerable accuracy The actual amount is very small, but, as will be shown, it has very important effects If the various gases of the atmosphere were all separated from each other and brought to a layer uniform in density at normal temperature and pressure, the thicknesses of the layers of different gases would be as given below

Gas	Nitrogen	Oxygen	Argon	Carbon dioxide	Neon	Helium	Ozone
Thickness	6 2 km	1 7 km	76 m	2 4 m	10 cm	9 2 cm	3 mm

This shows how very little ozone there is compared with the other gases, but the effect of even this small amount is by no means unimportant , thus, it prevents excessively strong ultra violet radiation from the sun, which would cause intense sunburn and other effects, from reaching the earth, and it is further responsible for raising the temperature of the atmosphere at great heights to values far above those of the stratosphere and probably nearly up to the normal boiling point of water

Turning now to the methods used for measuring the amount of ozone in the atmosphere, this is always done by spectroscopic means Ozone has an exceedingly strong absorption band in the ultraviolet region between about 3200 A and 2200 A , so that if we measure the absorption of light of a suitable wave length while passing through the atmosphere, we can deduce the amount of ozone through which the light has passed In practice it is not convenient to measure the absolute intensity of one wave-length, but we measure the ratio of the intensities of two adjacent wave lengths, chosen so that one is strongly absorbed by ozone while the other is but little absorbed By this means we largely eliminate changes due to haziness in the lower atmosphere and also changes in the energy emitted by the sun

For most of the work so far accomplished, photographic instruments have been used, and spectrograms of sunlight are taken under carefully controlled conditions so that the energies in the different wave lengths can be accurately determined With these instruments there is naturally a most inconvenient delay due to developing and measuring the plates before the ozone content can be deduced , further, the labour is very great Photoelectric methods are now available which allow exceedingly small amounts of light to be measured, and these when used in conjunction with a suitable double spectroscope, allow the ozone to be easily measured within a total time of about five minutes at all times when the sun is more than about 10° above the horizon, whether the sky be cloudy or not If the sky be clear, measurements can be made even when the sun is much nearer the horizon Indeed we may say that, provided the sun is sufficiently above the horizon, we can measure the amount of ozone in the upper atmosphere nearly as easily as we can measure the barometric pressure and with an accuracy approaching that of barometric readings, when we take into account the 'correction to sea level' to be applied when comparing barometer readings at different places, which is often rather uncertain for stations at some little height above sea level

The height of the ozone in the atmosphere can be deduced by taking measurements when the sun is rising or setting, since in these conditions the calculation of the amount of ozone involves both the height of the ozone and the curvature of the earth The method is not very accurate but a large number of measurements show that the average height of the ozone layer is about 50 km above sea-level We do not yet know how far above or below this height the ozone layer extends

When measurements of the quantity of ozone are made in temperate latitudes, it is found that there are large variations in the amount present from day to day, amounting to nearly 50 per cent of the mean value There is also found to be a well marked annual variation, having a maximum in spring and minimum in autumn The day to day variations show a close connexion with the meteorological conditions in the upper troposphere and lower stratosphere, the amount of ozone being high when the temperature of the troposphere is low, when the pressure near the base of the stratosphere is low, and when the height of the base of the stratosphere is low, and vice versa The number of meteorological observations reaching a height of more than 15 km is not very large, but such observations as there are indicate that the amount of ozone is closely related to the pressure up to the

* Friday evening discourse delivered at the Royal Institution on Mar 6

greatest height where observations are available It has also been shown by Dr Duckert that the amount of ozone is closely related to the density of the air about 15 km and above but not with that at a lower level Considering that the comparison has necessarily to be made between ozone measurements made at one place and meteorological observations made 90 km or more away and often some hours different in time, it is remarkable that correlation coefficients so high as 0 80 have been found

When the distribution of ozone is compared with the distribution of barometric pressure, a close relationship is again found Unfortunately, the meteorological observations are not available from which maps showing the distribution of pressure and temperature at various heights in the atmosphere can be drawn, but even the surface distribution shows that the two are closely associated Observations were made at seven places in north-west Europe in order to study this relationship during 1926 and 1927, and the distribution of ozone in the different regions of a typical cyclone or anticyclone are shown in Figs 1 and 2* At the time when these measurements were made, only the older photographic spectrographs were available, and these could not be used when the sun was low or when the sky was cloudy, so that measurements had to be stopped during the winter, and even in the summer a large number of days were missed owing to cloudy skies Thus the information at present available is very meagre, but there is no doubt whatever that in practically all cyclones the distribution of ozone is roughly as indicated in the accompanying figures, and there are indications that cyclones only form when there are large differences of ozone in adjacent regions It was seen that the relation between the amount of ozone and the meteorological conditions at any one given place is very much closer if the conditions in the upper air are taken than if surface conditions are considered, and there is reason to think that if we were able to draw pressure and temperature maps for a height of, say, 10 km., we should find that the distribution of ozone

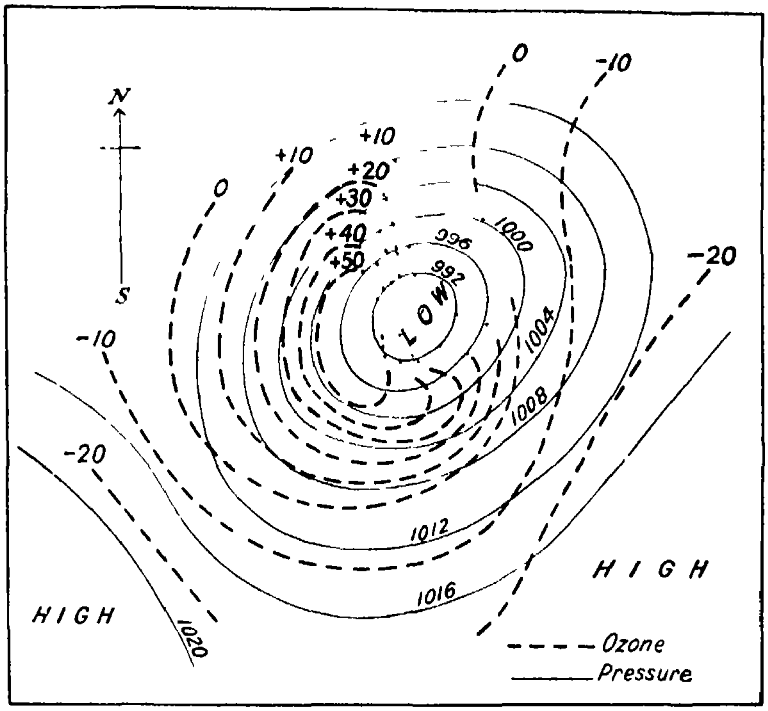


FIG 1

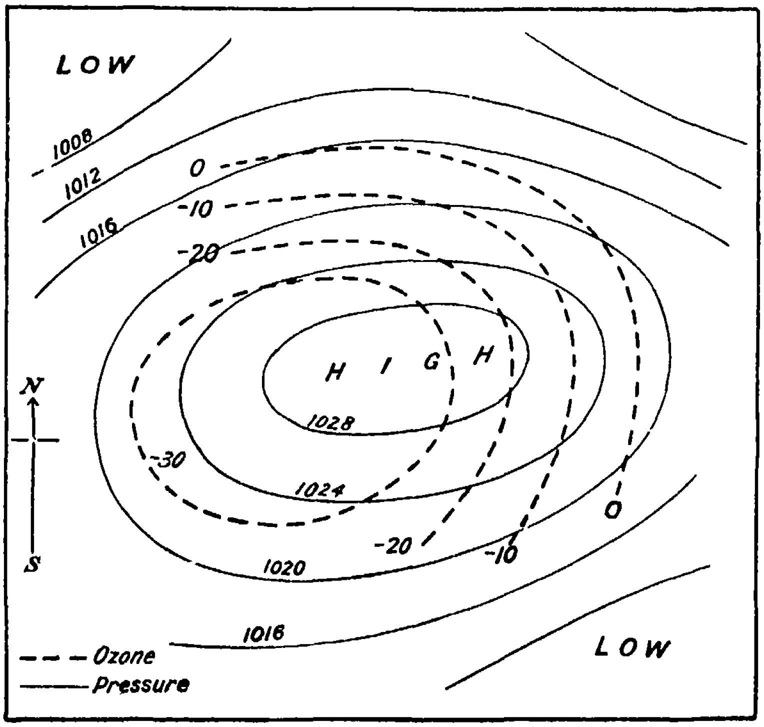


FIG 2

* The illustrations in this article are reproduced, by kind permission, from the *Proceedings of the Royal Society*

showed an even closer connexion than that found using maps for the surface

When we turn to the distribution of ozone over the whole world, we find that the relatively few measurements so far made give a fairly definite picture of the main outlines These are best seen from Figs 3 and 4, which both show the same results but presented in a different manner It will be seen that at all latitudes outside the tropics there is a definite annual variation, with maximum in spring and minimum in autumn both in the north and south hemisphere Within the tropics the amount of ozone is small at all seasons, and it is noteworthy that even such big changes as the Asiatic monsoon appear to have no effect on it, presumably because the ozone is at a much greater height than is reached by the monsoon In the spring there is a very rapid rise in the amount of ozone from the equator to the pole, the amount at the pole being more than double, and possibly treble, that at the equator On the other hand, in autumn there is but little change in the amount of ozone over the whole hemisphere These results seem to be true for both north and south hemispheres, and though there have been only about one year's observations at most of the stations, it is thought that while another year may give slightly different values, the general conclusions are not likely to be changed

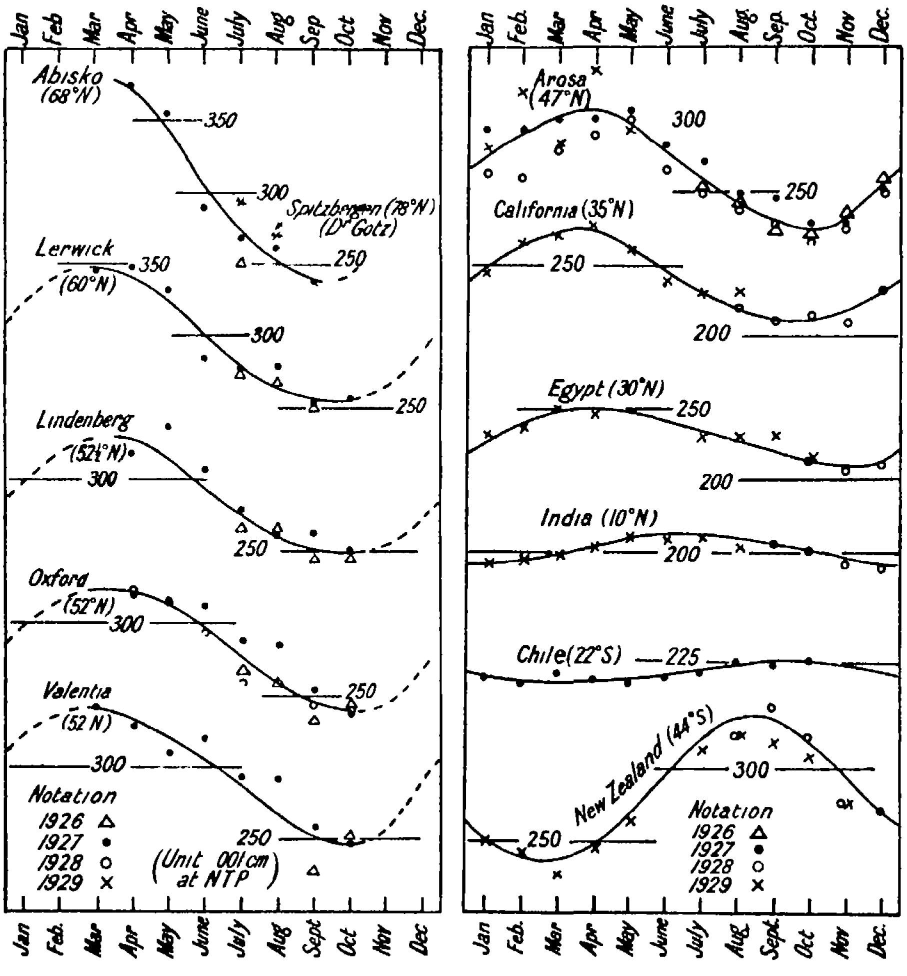


FIG 3

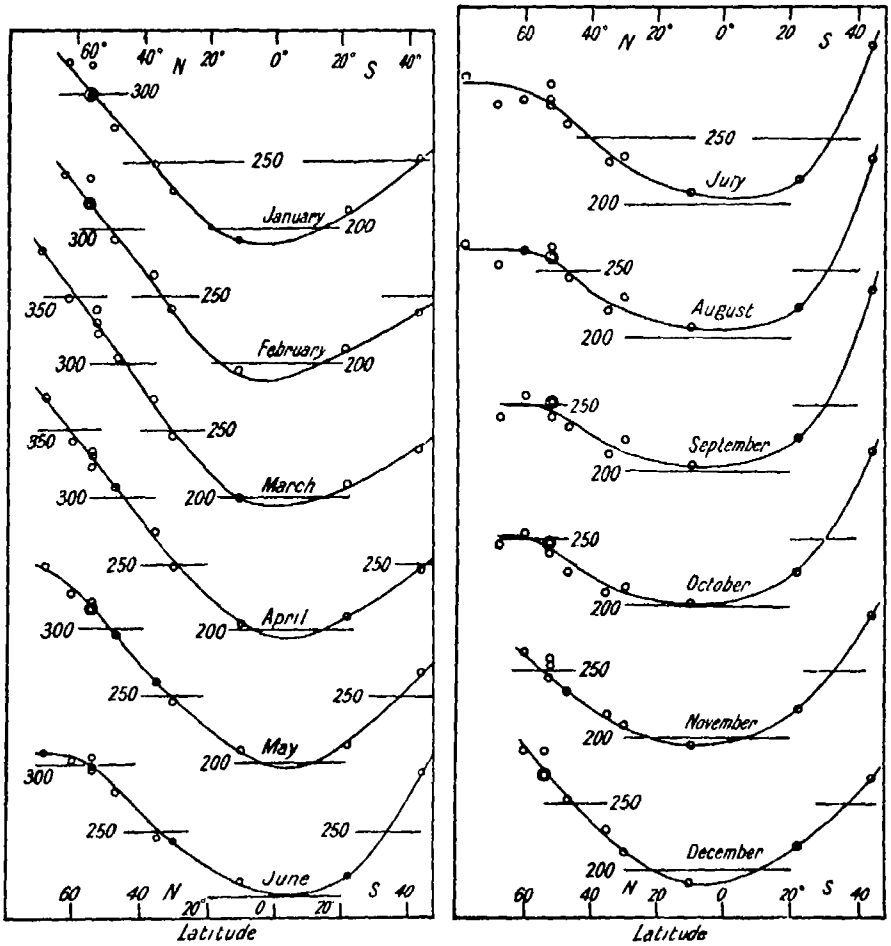
We come now to the obvious questions What forms the ozone in the upper atmosphere, and why is the amount so closely associated with the other meteorological conditions if the ozone is really at a height of some 50 km ? It was at first supposed that the shorter wave-lengths of the sun's radiation, by breaking up oxygen molecules into atoms which combined to form ozone, was the chief cause This view is difficult to reconcile with the high value found in polar regions in the spring and the steady low value within the tropics It has been thought that this difficulty can be overcome, but we believe that it is fatal to the view that solar ultra violet radiation is the chief cause Since there have never yet been more than seven stations measuring the amount of ozone in Europe at one time, it is not possible to say for certain whether the amount of ozone is ever increased locally by formation over a limited area, but it is probable that this may happen If so, it would be quite fatal to the hypothesis of ultra-violet light, since it would seem that this must affect a large area of the earth's surface alike The only other suggestion is that it is formed by some action connected with the aurora This would account for the high values at the poles, and in this case there is no reason why ozone should not be formed in small local areas The annual variation is also easily accounted for on this view, since Dr Gowan has shown that owing to the absorption of about six per cent of the sun's radiation by the ozone, its temperature will be relatively high and the higher its temperature the faster will it decompose Hence we should expect the amount of ozone to be small after the sun has been strongest and large when the sun has been cut off, as at the poles at the end of the winter There is, however, at present, no certainty in this matter

The relation between the amount of ozone and

the meteorological conditions presents even greater difficulties There are good reasons for thinking that the average height of the ozone layer is appreciably the same at all times of the year and whether the amount of ozone present be large or small This seems to rule out any suggestion that in polar regions there is ozone in the lower stratosphere and that this is carried to lower latitudes by the polar currents which are well known to be associated with cyclones Even if we suppose that the great polar and equatorial currents extend up to 50 km and so transport ozone at this height, there are difficulties, for, as shown above, while there is a great difference between the amount of ozone at the pole and the equator in spring, there is but little difference in autumn, so that on this hypothesis the rear of cyclones should have much ozone in spring but there should be a nearly uniform distribution in autumn This is far from being the case

Again, so far as we can tell at present, the amount of ozone in the rear of a cyclone in Europe during the autumn seems to be greater than the normal amount anywhere within that hemisphere at that season Thus, there is nowhere from which the ozone might have been transported, and we are almost driven to supposing that it is formed in the area where it is found If this is so, there are three possibilities either the presence of a cyclone causes ozone to be formed in the atmosphere above it, or a local increase in the amount of ozone leads to the formation of a cyclone in the atmosphere below it, or thirdly, both cyclones and ozone are formed by some common agency At present it does not seem possible to settle this question without further and fuller observational material, and for this reason it is hoped to organise ozone observations at at least a dozen stations in Europe with the new photoelectric instruments, which have none of the disadvantages of the older photographic ones, and one may hope that results of great meteorological interest will be obtained

In addition to the connexion between the amount of ozone and the meteorological conditions in the lower atmosphere, there are also other notable effects produced by it Although the amount of ozone is so small, its absorption band in the ultra-violet region is so strong that it absorbs practically all the solar radiation of wave-length shorter than about 3000 A reaching the outer atmosphere Altogether, it absorbs about six per cent of the incoming solar energy Thus, one effect of the ozone is to reduce enormously the power of the sun to produce sunburn, and it would be impossible to stay long in the sun without serious effects if it were not for the atmospheric ozone



c d

FIG 4

Another effect of the absorption of so much solar energy in the high atmosphere is that the temperature at these heights is raised much above that lower down Since the ozone has only a weak emission band in the infra-red, it cannot easily lose energy by radiation, and most of the heat absorbed in the high layers is probably radiated by the small amount of water vapour there Estimates made by Dr Gowan of the temperature show that at a height of 50 km a value of 400° A is not unlikely Dr Whipple has shown that the high temperature at heights of about 50 km is responsible for the abnormal audibility of sound from great explosions at distances of 200 km or more from the source Measurements made by

Dr Whipple on the sound waves from artillery fire in Great Britain indicate temperatures up to nearly 400° A at a height of some 45 km, agreeing well with Dr Gowan's estimates

If the ozone is formed by some action connected with the aurora, we should expect that the amount of ozone would show a connexion with the intensity of the visible aurora Unfortunately, with the instruments which were used until recently, it was not possible to make measurements of the amount of ozone in the higher latitudes in winter, and as the aurora cannot be seen in summer, there are too few suitable observations to determine with certainty whether the effect is shown or not There is, however, a small but definite connexion between the amount of ozone and terrestrial magnetic conditions, days of high magnetic character tending to have much ozone, and vice versa This is what we should expect if the ozone were associated with the aurora It is also significant that a large amount of ozone seems to be associated with magnetic disturbance but not with a large amplitude of the normal diurnal variation on magnetically quiet days, which we may suppose to be due to increased ionisation caused by ultra violet radiation

This is, briefly, the state of our knowledge of atmospheric ozone at the present time, which is due to researches by several workers during the past five or six years When the whole story of the part played by ozone in the extreme upper atmosphere has been unravelled, it seems likely to afford material of great interest

The Centenary of the British Association

IN 1831, when the British Association was founded, the opinion was freely expressed that there was no useful work for it to do At the very successful jubilee meeting at York in 1881, fears were felt for the future the view was held in some quarters that the Association's work was done

> "At York they thought she was sure to die,
> For she didn't seem to enjoy age "

So roared the Red Lions of the day, rather mysteriously feminising the 'British Ass' An interesting historical parallel has already been encountered in the present centenary year—an expression of precisely the same opinion by more than one person unconnected with the Association There is therefore every reason to hope that at least another century of useful work lies before it

Certainly the preliminary programme of the meeting shows promise of exceptional interest for scientific workers and laymen alike The programmes of the Association can never be accused of pandering to the public interest It is not necessary that they should If a discussion with an arresting headline happens to appear (such as "The Evolution of the Universe", which is found in the present programme), it may be taken that men of science have something to say on this subject to each other, not that they merely wish to tickle the curiosity of the public Actually they can do both, and in the present year, what with the Faraday centenary immediately preceding, and the Clerk Maxwell celebration, and the jubilee of the Natural History Museum immediately following the Association's week, there ought to be a gathering of the 'cultivators of science' (to revive the phrase of 1831) such as has never been seen before, in Great Britain or elsewhere The Association, at any rate, is doing what it can to give the occasion an imperial and, indeed, a world-wide significance by inviting representatives from all the places where it has met in the past, both at home and in the dominions, and also a notable list of foreign guests Already there is a welcome response to these invitations Fairfield Osborn, Gregory, and Cattell, Adamson, Torry, Kerr Grant, and McLennan, Ehrenfest, Zeeman, Thilenius, Sergi, Hevesy, Debye, Matschoss—these are names taken almost at hazard from the list

The mechanism of the Association is adapted by experience to a meeting in any large town except London Anywhere else than in London the civic and the cultural spirit of the place forms a unit which never fails to co operate in receiving the Association, powerfully aiding its organisation in all that appertains to local arrangements, and providing a quota of local members to take the opportunity of participating in its transactions In London there is no such unit it is too big Not that there can be suggested any lack of co-operation, when the City through its Court of Common Council first expressed the hope that the centenary meeting would be in London, and the Lord Mayor recently presided over a meeting held in Guildhall to hear the Association's aims when H M Government has promised a reception, when the London County Council, the City of Westminster, and the Royal Borough of Kensington through their principal officers have shown active interest in the arrangements, and when all the great institutions in South Kensington have freely lent their splendid accommodation for the meeting and promised other facilities Moreover, members attending the meeting will have a unique opportunity of visiting, again with the generous co-operation of the authorities concerned, a selection of the places of scientific interest in London at large, of which places the number is immense, and members will not fail to realise that this opportunity, so far as concerns the Association, will presumably not recur until 2031 Accepting these good gifts, but knowing that it has not on this occasion a local organising unit with which to deal, the Association has set itself to undertake a good deal of the 'local' side of the arrangements, and has backed its luck in respect of their cost The unknown factor at present is the response of the London public to the stimulus of an Association meeting, the support by way of membership and financial contribution which may be looked for in London

John Perry, the former general treasurer of the

Association, was wont to say that the centenary meeting must be held in London He viewed the occasion with a treasurer's eye, hoping for a great membership and a substantial addition to the funds Without doubt, also, he foresaw the need for a more adequate permanent endowment of the Association The writer was present when Perry was told of Sir James Caird's gift of £10,000 to the Association at the Dundee meeting in 1912 "Very liberal", was his comment, in effect, "it should be an example to others", and thereafter he was concerned to persuade the donor that the whole sum should not be spent at once (as was at first desired), but held as an endowment toward the researches which the Association helps with grants The example was indeed followed in later years, by the late Sir Charles Parsons and Sir Alfred Yarrow, whose benefactions to the Association were made for its 'general purposes', and by Mr Buckston Browne, whose gift and endowment of Darwin's house at Downe have already so far reacted upon the general purposes of the Association that it has materially enhanced its prestige

The Association has undertaken a heavy task in trying to raise the Centenary Fund of £40,000, primarily because, in colloquial phrase, times are bad, and partly, perhaps, because it is not possible to set forth one big immediate object There are, of course, the extraordinary expenses connected with the London meeting will London take note of this? For the rest, the appeal is made rather because those responsible for the administration of the Association, looking to the future as well as viewing the past, know that the Association might better use its high position and influence if it had the means This is not the place to discuss all the objects of the appeal—they can be learned from the official statement, which has been widely distributed and can be obtained from the office on request In brief, however, the Association is, in a financial sense, an exacting guest of those places where it is invited to meet, an exacting taskmaster of those who voluntarily serve it too much so If any centre of human culture conceives that it would be benefited by a visit of the Association, it should in theory be possible for the Association to answer "Yes, we will come", instead of being compelled to ask the question, "Can you raise so much of a fund for our reception, and assure us of a sufficient membership?" This question is becoming the more pressing at the present time, because from more than one quarter of the overseas territories of the British Empire inquiries are reaching the Association whether there could be held in them, not a full annual meeting, but a congress of representative workers in all departments of science from the homeland, to meet the cultivators of science on the spot This would introduce a principle new to the working of the Association, but how desirable! It is to be remembered also that the Association is the only body in the Empire qualified by the breadth of its field to meet such requests, but financially it is not qualified

Consider, again, the grants for research which the Association has honourably if modestly maintained without intermission since its very early years Its administrative expenses, small as they are in comparison with the immense volume of voluntary effort by which its working is really carried on, and much (too much) of them as it delegates to the funds voluntarily contributed to the local organisations in the places where its meetings are held, depend in large measure upon its membership subscriptions But suppose that those expenses were covered by its permanent endowment Then, indeed, the Association would have a rallying call for membership which at present is wanting The invitation to membership would mean not merely an invitation to a week's scientific meeting, as it does now, but also the ability to state that membership of the Association connoted the support of research—and that would give the Association what it now definitely lacks a much wider appeal for permanent, as distinct from temporary and fluctuating, membership "Every membership subscription is a subscription to scientific research" If the Association could start its new century with that slogan, its supporters could feel that they had built truly upon the foundation laid in 1831

Obituary

PROF W C M'INTOSH, F R S

THE death of Prof W C M'Intosh at St Andrews on April 1, at the patriarchal age of ninety two, broke a link with the great naturalists of a long past epoch and closed a career pursued to the very end with single minded devotion and an industry that seemed as if it could never flag Only ten days before, he had come to London to preside at a meeting of the council of the Ray Society, but the long train journey back to St Andrews in a bitter east wind proved too much even for his iron constitution

William Carmichael M'Intosh was born at St Andrews on Oct 10, 1838 He was educated at Madras College and at the Universities of St Andrews and Edinburgh, where he studied medicine He received the degree of M D at Edinburgh in 1860, and was awarded a gold medal for his thesis, "Observations and Experiments on *Carcinus mœnas*" This essay, which he republished a few years ago, dealt mainly with the physiology of the nervous system in the shore-crab and its reactions to various drugs He specialised in the study of mental disease and published several papers on the subject, becoming superintendent of the Perthshire Asylum at Murthly in 1863

At Edinburgh, where he studied anatomy under John Goodsir, M'Intosh had published a paper on the arrangement of the muscular fibres in the heart of the bird, but another of his teachers, G J Allman, seems to have turned his attention more decisively towards marine zoology, a subject

that had attracted him since his boyhood on the shore at St Andrews He began early the long series of faunistic papers which were continued down to the last years of his life, on the marine invertebrates, chiefly of the North Sea, but with occasional excursions so far afield as the Outer Hebrides and the Channel Islands A number of preliminary papers led up to his great monograph of the British marine annelids, published by the Ray Society, of which the first volume, dealing with the nemerteans, appeared in 1873–1874 and was at once recognised as marking a great advance in the knowledge of these animals

The nemerteans are in some ways a peculiarly difficult group for anatomical study Many of them are too large for examination of the whole animals to reveal much of their structure Their pulpy consistency and the fact that the organs are embedded in a continuous parenchyma make dissection all but impossible, and the technique of section cutting was then in its infancy Later investigators, with vastly improved methods, have added much detail but have found surprisingly little to correct in M'Intosh's work Dr Otto Bürger, in his monograph of the Naples nemerteans, refers to "Die glanzende Monographie von M'Intosh" as having reduced to order the chaotic systematics of the group Many years were to elapse before the continuation of the monograph, and the remaining volumes, dealing with the Polychæta, *although of great and permanent value*, had not the novelty and importance of the nemertean work

Meanwhile M'Intosh had dealt with collections of polychætes from many parts of the world, the most important being that of the *Challenger* expedition, on which two stately volumes were published in 1885 In the course of his work on the *Challenger* material he received, for study, the specimens of the problematical organism which he named *Cephalodiscus*, which had been sent to various other specialists and returned by them as not belonging to the groups they were studying M'Intosh gave a detailed description of *Cephalodiscus* and correctly recognised its affinity to *Rhabdopleura*, but it was Harmer who, in a postscript to M'Intosh's report, pointed out its relationship to the Chordata

In 1882, M'Intosh was appointed to the chair of natural history in the University of St Andrews, which he was to hold until 1917, and shortly afterwards he took up another line of work that engrossed his attention for many years While at Murthly, he had published several papers on the life-history of the Tay salmon, and it was no doubt this that led to his selection to conduct investigations for the Royal Commission under Lord Dalhousie, which began in 1883 to inquire into the problems raised by the introduction of beam trawling and its effect upon the sea fisheries Although by no means immune to the discomforts of work at sea, M'Intosh threw himself into the task with his wonted energy and enthusiasm Perceiving the need for laboratory work on shore, he succeeded in establishing at St Andrews the first marine laboratory in Great Britain This was opened in 1884 in a small wooden building which had been hastily erected a few years before for use as a fever hospital It is scarcely too much to say that for the next ten years this mode[st] establishment was the headquarters of Britis[h] marine research The list of zoologists who worked there includes the names of Ray Lankester, Haeckel, Dohrn, Hubrecht, Nansen, Burdon Sanderson, Gotch, and many others of like distinction When, in 1896, the wooden laboratory was replaced by the stone building provided by the generosity of Dr C H Gatty, St Andrews no longer stood alone, and the necessary support became increasingly hard to obtain Since the War the Gatty Laboratory has stood shuttered and deserted

It was in 1865 that the late Prof G O Sars, of Norway, laid the foundation of scientific fishery research in a little paper in which he traced the life-history of the cod and showed that its eggs float on the surface of the sea His work was followed up to some extent in the United States, but it was M'Intosh and his pupils who first showed that practically all our marine food-fishes, with the notable exception of the herring, have pelagic floating eggs, and by their detailed descriptions of the eggs and larval stages made possible the modern developments of fishery research

At the time of his death M'Intosh was the senior fellow of the Linnean and several other scientific societies From the Royal Society, to which he was elected in 1877, he received the Royal Medal in 1899, and the Linnean Society, of which he had been a fellow since 1863, awarded him its Linnean Medal in 1924 He was president of the Ray Society from 1913, and took an active part in its affairs up to a few days before his death

M'Intosh was unmarried Of his three sisters, one, who became the first wife of Dr Albert Günther, was an accomplished artist, and exquisite coloured drawings of marine anim[als] adorn many of her brother's works Her s[on] Dr Robert T Gunther, curator of the Lewis Ev[ans] collection at Oxford, is a well-known zoologist, [and] the family tradition in this respect is maintai[ned] by his son, Mr E R Gunther, one of the natu[ral-] ists of the *Discovery* investigations, now on bo[ard] the R R S *William Scoresby* in the Antarctic

To many generations of the wearers of [the] scarlet gown, the erect and dignified figure [of] Prof M'Intosh must have seemed as muc[h] part of St Andrews as the United College To[wer] or the links or the sea Many who never ente[red] his class-room will have learned of his death w[ith] a sense of personal loss W T C

MR T C CANTRILL

MR THOMAS CROSBEE CANTRILL, who died o[n] April 3 at the age of sixty-three years, was one of t[he] pupils who studied under Prof. Charles Lapwor[th] at Birmingham, where he graduated as B Sc A[t] the age of twenty-eight he joined the Geolog[ical]

Survey of Great Britain, and served continuously on the field staff for thirty-one years, being appointed a district geologist in 1914

Attracted to geology at an early age, Cantrill investigated the structure of the Forest of Wyre, and after joining the Geological Survey his work was for a considerable time centred in the South Wales Coalfield under the superintendence of Sir Aubrey Strahan Thereafter he took charge of the West Midlands district, of which Birmingham may be regarded as the centre, but he also edited and prepared for publication several memoirs on the North Wales Coalfield

The principal contributions made by Cantrill to geological literature will be found in the long series of Geological Survey memoirs to which he was a contributor Thus, for example, he was one of the authors of nine memoirs on the South Wales Coalfield and of more than a dozen other memoirs on the West Midlands and North Wales As a coalfield geologist he had not only vast experience but also sound judgment and great diligence After a breakdown in health in 1921 he resumed his official duties, retiring in 1927, when he took up his residence in his native county of Worcestershire and devoted his leisure to the study of archæology, of which he had always been an enthusiastic student Several contributions from his pen on these subjects have appeared in the publications of local antiquarian societies

Cantrill was a field geologist who showed great devotion to his work and exerted much influence on his colleagues by the strength of his character and the unselfish manner in which he gave assistance to all who made demands on him Though naturally of a somewhat retiring disposition, he made many friends in the districts in which he worked, who were attracted to him by his kindly disposition, his sincerity, and his sympathetic personality

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WE regret to announce the following deaths

Sir Byrom Bramwell, lately president of the Royal College of Physicians, Edinburgh, and a distinguished neurologist, on April 27, aged eighty three years

Prof Raoul Gautier, honorary professor of astronomy in the University and director of the observatory of Geneva, who was vice president of the International Association of Geodesy, on April 19, aged seventy seven years

Dr Emil Trinkler, known for his explorations in Afghanistan in 1924 and in the Kuen lun Mountains, Afghanistan, and Tibet in 1927-28, on April 19, aged thirty five years

Dr A P Weiss, professor of psychology at the Ohio State University and associate editor of the *Journal of General Psychology*, on April 3, aged fifty one years

News and Views

FOR many years now, a popular belief has existed that seeds which have been removed from ancient tombs retain their ability to germinate Wheat grain, the so called 'mummy wheat', has been a case in point for several decades This question was brought forward again during the discovery and examination of the tomb of Tutankhamen in 1923, by Mr Howard Carter and Lord Carnarvon, and has received attention from various quarters since that date Now another claim has been made by an American farmer, that wheat taken from the tomb of Tutankhamen has been made to grow, and this fact has received much publicity in the press It is all a question of viability The viability of a seed depends on several factors, both internal and external Some seeds will not germinate immediately, and are said to be dormant, such dormancy again being conditioned by after ripening processes, etc The result is that seed viability varies considerably within the plant kingdom For example, the acorn is viable for one season only, whereas charlock will last for twenty or thirty years Hawthorn, even given germinating conditions, remains dormant for the first season, but immature wheat will germinate, given the necessary conditions, as seen in the case of wheat germinating when still in the ear, during a wet season On the other hand, mature wheat is viable for some considerable time Not only that, the grain will withstand extreme conditions to an exceptional degree

OTHER plants show a similar tendency The subject was discussed in an article by the late W Botting Hemsley in NATURE of May 2, 1895, p 7, exactly thirty six years ago He states there that kidney bean seeds, which had remained in the herbarium at Tournefort for a hundred years, germinated, and *Mimosa pudica* will remain viable for sixty years But the viability of wheat thousands of years old is a different matter Sir E A Wallis Budge states in the *Times* of April 23 that grain from a tomb of date 1200 B C was tested for him by the late Sir William Thiselton Dyer at Kew, and gave negative results Many others, too, have tried since, with similar results Yet, such positive results as claimed by some, need explaining The question is Were such claimants sure of their wheat ? For hundreds of years, the halls of tombs have been used as granaries by the natives The grain can conceivably be ascribed to that, and therefore possibly be only a few years old Also, 'mummy wheat' has become so popular that guides have resorted to tricks whereby they dig up 'mummy wheat' (in the presence of the tourist) which the guides themselves had placed there some time before So far, there has not been one authentic case of 'mummy wheat' being viable, and it is extremely unlikely that there ever will be A viable seed is still living and therefore respiring, however slowly Decay is therefore taking place, since there is no anabolism Such decay varies in rate, but it is not likely that it is so slow as to last over thousands of years

ON April 23, an Empire trade gathering which emphasised the enormous wealth in precious metals of the British Empire, and especially of Canada, assembled at the Acton Precious Metals Refinery for the opening of extensions The ceremony was

followed by a luncheon, at which Lord Weir presided, the Government being represented by the Right Hon J H Thomas, and the Dominion of Canada by the Hon G H Ferguson The extensions have been necessitated by the enormous new supplies of platinum metals recently developed in the Sudbury district of Ontario, as by products of nickel and copper These are expected to be produced in the proportions of platinum and palladium, about 40 per cent each, rhodium, ruthenium, osmium, and iridium, 7 per cent, and gold, 13 per cent When the Refinery was first opened in 1924, its capacity was 40 000 ounces a year, whereas its extended capacity will be 300,000 ounces Since the total world consumption is less than 400 000 ounces per annum, the Acton refinery will be able to refine from Empire sources three quarters of the world's demand

THERE already exists a wide variety of uses for platinum metals and these will naturally be developed further as the new supplies become available Platinum itself, found until recently exclusively in sands and gravels and chiefly in the Urals or Colombia, apart from its use in jewellery, is of first importance to the dentist and the surgeon, and is used extensively in laboratories on account of its high melting point and immunity from most chemical reagents It is also used in the making of permanent photographic prints, in the ceramic industry, in the artificial silk industry for spinnerets, and for many electrical purposes Agriculture throughout the world depends on platinum, as fine platinum gauze is used in the oxidation of ammonia during the manufacture of synthetic fertilisers Of the other precious metals, palladium is used for much the same purposes, but it is anticipated that further uses will now be found One in course of development is the plating of white gold and silver to render these metals non tarnishable The palladium plating of microscopic parts, spectacle frames, and automobile and aerodrome reflectors, to render them non tarnishable, is rapidly approaching the commercial stage The other platinum metals are mainly used to alloy with platinum and palladium Platinum was discovered so far back as 1750, and ruthenium, the last of the group, no more recently than 1845

AT a meeting of the Section of the History of Medicine of the Royal Society of Medicine, under the presidency of Sir Humphry Rolleston, on April 15, his brother, Dr J D Rolleston, an ex president of the section, read a paper entitled "Jean Baptiste Bouillaud (1796–1881) a Pioneer in Cardiology and Neurology" Bouillaud's treatise on diseases of the heart, of which the first edition was published in 1835 and the second in 1841, formed an important landmark in the history of cardiology, his two chief French predecessors in this field being Senac, the contemporary of Voltaire, and Corvisart, the medical attendant of Napoleon The contributions of Bouillaud to cardiology were summed up under the following six headings (1) the first description of the endocardium and endocarditis, (2) his 'law of coincidence', in accordance with which affection of the heart is the rule in acute rheumatism, (3) his elaborate studies of the normal heart, whereby he created a new department of topographical anatomy, (4) the importance which he attached to auscultation of the heart in contrast with Laennec, who under estimated its value in cardiac as distinct from pulmonary diseases, (5) his description of new physical signs in cardiac disease, and (6) his detailed account of congenital heart disease

THE pioneer work of Bouillaud in neurology consisted in his identifying the anterior lobes of the brain as the seat of speech thirty six years before Broca, who, though he localised it more precisely in the third left frontal convolution, acknowledged his indebtedness to Bouillaud, and in showing that the cerebellum was concerned with movements of co ordination, in opposition to Gall, who regarded it a the organ of the instinct of propagation In addition to his contributions to cardiology and neurology, he made an important advance in the study of acute rheumatism, which is still known in France as Bouillaud's disease Although a stalwart vitalist, he was one of the first to recognise the importance of chemistry and physics in medicine, in contrast with his contemporary the great clinician Trousseau, who was inclined to depreciate the value of these studies In conclusion, Dr Rolleston showed by quotations from contemporary literature that Bouillaud never received much appreciation during his lifetime in Great Britain, and suggested that the chief cause of the oblivion into which he had fallen was his practice o repeated and free venesections, with which he persisted long after it had been generally abandoned elsewhere

THE April issue of the *Hibbert Journal* contains an interesting article by Sir Oliver Lodge on "The Interaction of Life and Matter" He attempts to interpret the behaviour of animated bodies in terms of a "biological field", just as the behaviour of inanimate particles is interpreted in terms of an electric or magnetic field He admits that the parallel is not complete "In a gravitational or an elastic or any other field, energy is stored and expended those fields belong to the physical universe, and their energy has to be taken into account In life apparently there is no specific energy Life is not energy, it merely directs the energy which it finds available" The element which life adds is not energy but guidance, it directs energy into channels which otherwise might have been unoccupied Yet how life can direct energy without expending energy itself has always been an insoluble problem

SIR OLIVER LODGE here suggests that the possibility of a directive yet non-energetic agency is not excluded by the present state of physical knowledge "Modern physics has shown that every particle has associated with it something periodic The electron does n now appeal to us as a minute spherical charge a nothing else, it has been found to have someth associated with it, a series of waves In fact, i found that many of the properties of a part

matter can be possessed by what is known as a 'group wave', in other words, that the energy of a particle can be expressed as the energy of a set of group waves, and that these, strangely enough, obey the laws of dynamics. Consequently it is realised that the particle and the wave are much more united than ever they have been before. A wave may exist without a particle. A particle can hardly exist without a wave. The waves seem the most fundamental things." Of these waves, Sir Oliver says that they are "mere forms that convey or transmit no energy", they are in fact "not effectively energetic", "their progress is not like that of a material entity, and yet they are supposed to guide the particle to its destination". In other words, they "exercise a controlling and directing influence without imparting any energy". They may be said to act like the rails which guide a train. The hypothesis suggested is that "these form waves constitute the physical mechanism whereby life and mind operate on and direct material particles". The suggestion is an interesting one, and we shall wait to see how far this application of recent physical theory will commend itself to physicists on one hand and to physiologists on the other.

THE Friday evening discourse on April 24 at the Royal Institution was given by Sir Philip Hartog, on Joseph Priestley. Sir Philip pointed out that Priestley was one of the most conspicuous figures in the eighteenth century, and has always seemed puzzling to his scientific biographers. Some of Priestley's best work is contained in his "History of Electricity" and his electrical papers, which have been very largely overlooked. He discovered that charcoal, blacklead, and red hot glass are conductors, suggested that there was a gradation of substances from the most perfect conductors to the most perfect non conductors, and tried to measure conductivity. He anticipated Cavendish and Coulomb, by showing from an experiment of Franklin, elaborated by himself that the attraction between quantities of electricity varies inversely as the square of the distance. Priestley initiated a new era in chemistry by increasing the number of known species of gas from three to twelve, and paved the way for the revolution effected by Lavoisier. His discoveries of the action of living animals on air, of oxygen on blood, and of the green matter of plants on air under the influence of light, have been of the greatest importance in animal and plant physiology. Finally, it appears from notes for a lecture in the Royal Institution in 1810 that it was a theorem of Newton's and certain observations of Priestley on the diffusion of gases that led Dalton to his atomic theory. Priestley's place in the history of science has been under estimated. There have been greater men of science than Priestley, but few whose discoveries have produced so rich a harvest.

DR. J. F. TOCHER, Croll lecturer in statistical methods in the University of Aberdeen, gave an address on April 24, at the Institute of Chemistry, on probable error in scientific investigations, especially as relating to physics and chemistry. In reviewing the methods of testing the accuracy of results, he demonstrated the fact that it is unsafe to rely on an average alone as representing the real value, even if a large number of observations have been carefully conducted to obtain it. It is necessary to make certain that all systematic errors due to the apparatus, the method, and the observer have been avoided. When these have been eliminated, the individual results follow the law of error and contain only the unavoidable experimental errors, similar to those in making an attempt to measure a yard correctly. The measure of these unavoidable errors is known as the probable error, a single figure which gives a shorthand description of the extent of the variation in individual measurements. Dr. Tocher gave examples among others, of determinations of the atomic weight of hydrogen by Rayleigh, Morley, and others, and showed that, despite the extremely sensitive nature of the apparatus and care taken to secure accuracy, the results show a rhythmical variation. They swing from side to side round a specific value. Sometimes, however the individual results rise beyond the limit of unavoidable or random variations and betray an increase or a decrease which is systematic and avoidable. All that those engaged in research can do is to repeat their experiments until they acquire confidence in their accuracy and are able to formulate a reliable result. The calculus of probabilities has an important place in science; Clerk Maxwell described it as the true logic for this world and the only mathematics for practical men.

THE rapidly growing steel constructional work of the great electric power station at Battersea can now be seen from the Embankment. On St. George's Day, April 23, a remembrance stone, built into the station, was unveiled by Mr. W. F. Fladgate in honour of Michael Faraday, and a speech by Lord Bessborough, Governor General of Canada, who is a former director of the London Power Co., was telephoned by radio and broadcast at the ceremony. Lord Bessborough paid a glowing tribute to Faraday, who is recognised as the founder of the electric industry as we know it to-day. A hundred years ago, after much patient research guided by marvellous foresight, he discovered the phenomenon of the induction of electric currents and tabulated the laws governing it. Lord Bessborough said that science has no frontiers; the whole world is its parish. He pointed out that to Canada the 'white coal' of electrical energy means perhaps more than can be measured in the development of the Dominion. In the great metropolis of the Empire, this potent force is working for the betterment of the people in many ways. Faraday's discovery has been a boon to the world, and the Canadians participating on the other side of the Atlantic remember with gratitude the beneficent debt they owe to Faraday. After the remembrance stone was unveiled at the request of Lord Bessborough, Mr. Fladgate used a telephone near the tablet to convey the thanks of the assembled company to the Governor General.

THE Moorside Edge station of the British Broadcasting Corporation has now been completed. It is

the northern counterpart of the Brookman's Park station It is situated 1100 feet above sea level, about five miles from Huddersfield The three 500 feet masts can be seen from the L M S Railway which connects Manchester with Leeds Work has been begun on the third regional transmitter, near Falkirk, in Scotland The fourth is to be located in Somerset, but the site has not yet been chosen As each of the regional stations will radiate on two wave-lengths, transmitting alternative programmes, and as Daventry (5XX) and Belfast each radiate on one wave length, the whole of the ten wave lengths available will therefore be used The general equipment and layout of the Moorside Edge station practically duplicates that of Brookman's Park Great precautions have been taken to avoid interruptions to the programmes In each circuit, spare valves are provided which can be put in circuit at once by merely operating a switch The condensers and inductances are not bolted down, so they can if necessary be disconnected and removed at once The aerial masts, which form a right-angled triangle, are of lattice steel construction and each weighs 40 tons To avoid any unsymmetrical radiation from the aerials by 'mast shadow effect', each mast is insulated from the earth by porcelain insulators The formation of ice on the aerials, which might overload them mechanically is guarded against by passing large currents from the generators through suitable conductors on the masts, the req[illegible]d heat being given in about half an hour For its regional transmission, the Moorside Edge station will use a wave length of 479 metres, and for broadcasting the national programme it will use a wave length of 301 5 metres

Two valuable papers on standardisation have recently been read The first of these was read to the Royal Society of Arts on Feb 4, by Mr C le Maistre, director of the British Engineering Standards Association, and was entitled "The Effect of Standardisation on Engineering Progress" Referring to the present widespread dislocation of industry, which requires to be made the subject of scientific and systematic investigation rather than of party politics, he said the purpose of his paper was to show, in some small measure, the contribution which standardisation can make towards the solution of the problem by the introduction of greater economy in manufacture and distribution No one imagines there is any single remedy for trade depression, but it is an undoubted fact that standardisation, properly organised, is a most important factor in diminishing the excessive ups and downs from which industry suffers The second paper on the subject was read to the Institution of Automobile Engineers on Mar 3, by Mr L A Legros Commencing with a sketch of the history of standardisation, Mr Legros referred to the formation, in January 1901, of the Engineering Standards Committee, from which the British Engineering Standards Association sprang, to the work of standardisation done in connexion with the motor industry, to the progress of provisional standardisation, and to many practical aspects of the subject Quoting from an article by Mr B D Porritt, he said "Standards should result in something more than the stabilisation of quality and testing, it should be a fruitful field for improvement on both sides. If the time had come to visualise a national standardisation authority, such a body should treat standardisation as a means to the enhancement of the reputation of British goods"

The syllabus for the present term of broadcast talks to schools on rural science has recently been published by the Central Council of School Broadcasting There are two series of talks Mr C E Hudson is giving four talks on "The School Garden", on May 1 and 15 and June 5 and 19 Types of useful flowers for the school garden will be considered, and also methods of propagation by seeds and vegetatively and artificially (grafting and budding) The treatment of fruit trees, with special reference to pruning and fruit thinning, and the effect of such treatment will conclude the actu[illegible] scientific considerations This will be followed by the last talk, which is on the vocational possibilities of horticulture This should prove of exceptional interest, especially to children of rural schools in the vicinity of an agricultural or horticultural college "The Plant and the Soil" will form the subject matter of the other series of talks, to be given by Mr Ward Cutler This series will be composed of four talks, on May 8 and 22 and June 12 and 26 The series will begin by considering soil formation, and then various types, especially clay and chalk, with their typical flora, will be described Some very useful experiments are to be described, experiments which may easily be set up without the necessity for any elaborate apparatus The programme contains several good photographs and diagrams Judging from this pamphlet, the rural schools should look forward to two interesting and useful series of talks

The *Bodleian Quarterly Record*, vol 6, No 68, recently issued, contains a reprint of some exchequer accounts of the reign of Henry VI which give a description of a hitherto unrecorded visit of the King to Oxford in February 1439, the object of the visit being to witness a demonstration by a body of German master gunners and their company of their methods of projecting 'wild-fire', an incendiary composition better known as Greek fire In an introductory note to the documents, Mr E W Hulme says that the German artificers were brought to England by John Solers and that they stayed in Oxford nine days The employment of German artillerists in England was customary at this period On Nov 3, from Henry VI is recorded the payment of £40 "To Gokyn Gunner, Walter Lokyer, Walter Hermanson, and Gerard van Ewe, Gunnemeysters" from Germany, who for a long time remained in the King's service The name of John Solers occurs fairly frequently in the national records In 1438 he was appointed sergeant of the King's tents and pavilio[illegible] and in 1439 he obtained a twenty years' lease of [illegible] mines in Devon and Cornwall producing gold or silv[illegible] at a rent of one-fifteenth of the precious metals. [illegible] place of the German experiments in the history of [illegible] use of incendiary compositions in war can be fo[illegible]

by a study of Col Hime's "Origin of Artillery" and von Romocki's "Geschichte der Explosivstoffe"

THE Council of the National Institute of Industrial Psychology has recently issued its tenth annual Report (for the year ending Dec 31, 1930) In spite of the trade depression, the various activities of the Institute have increased in number and scope, and it is noteworthy that the importance of the human factor in industry is becoming recognised more and more Membership of the Institute has increased from 1430 to 1600, more requests are made for vocational guidance, and investigations have taken place in such varied industries as railways, meat paste, stores, and chocolate An important development is that firms are beginning to send their applicants for posts to be advised by the Institute as to the branch of the work for which the candidates are most fitted Apart from investigations, the Institute is doing research work into the nature and measurement of the mental abilities involved in factory assembly, colour discrimination, tests for perseveration, occupational prospects for boys, tests for motor drivers, etc Lectures and demonstrations have been in increasing demand A special appeal is being made for funds to continue the work, as research work cannot in the nature of the case be self supporting, and in memory of the Institute's first president it is proposed to call it the Balfour Memorial Fund

THE first number (vol I, No 1, pp 1–96) of the new publication, the *Veterinary Bulletin*, has recently been published, as announced in NATURE of April 25, it is to take the place of the *Tropical Veterinary Bulletin*, which ceased publication with the December number, with the addition of matter relating to animal diseases of temperate climates The *Veterinary Bulletin* will deal with all aspects of animal health in so far as they relate to original research and administrative control, but it will not deal with clinical material from the point of view of the practitioner, book reviews will be included The *Bulletin* will be of crown quarto size, 9¾ in by 7½ in, and vol 1 of this year will be issued quarterly and will run to about 384 pages From Jan 1, 1932, the journal will be published monthly and the volume will run to about six hundred pages The journal is published by the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, England, and the subscription price for the volume is £1, post free, payable in advance to that address (single copies will be 7*s* 6*d*) The subjects dealt with are classified under fourteen headings, most of which are represented in the abstracts in this first number Among the contents we notice that several pages are devoted to the *BCG* (Bacillus Calmette-Guerin) vaccine for tuberculosis, a subject which is attracting much attention at the present time, and nearly seven pages to *Bacillus abortus* infections and abortus and undulant fevers in man, another subject of much importance

THE Zoological Department of the British Museum (Natural History) has acquired, by purchase, a mounted specimen of a gerenuk, or Waller's gazelle (*Lithocranius walleri*) The animal has been mounted standing on its hind legs in the browsing attitude adopted by this species Although this antelope has been known to science only during the last fifty three years, excellent figures of it are found in Egyptian rock-carvings believed to date from about 5600 B C Its distributional range includes a very large part of the desert country of East Africa The Museum has also purchased the skin and skull of a pigmy hippopotamus (*Choeropsis liberiensis*) This species is found in Liberia and Sierra Leone The animal is not gregarious, spends most of its time on land, and is strictly nocturnal in its habits The zoological and entomological collections have been enriched by a large amount of material obtained by Capt A K Totton whilst a guest of the Atlantic Fleet during its recent visit to the West Indies The Department of Geology of the Museum has acquired some Jurassic insects from Bavaria, and a unique collection of Australian Triassic fishes The former are preserved in the famed lithographic stone of Solenhofen, and comprise some exquisite dragon flies The latter were gathered from a quarry, now closed, near Sydney This fish fauna is the only one known from the Middle Trias of Australia H M the King has sent 673 specimens of dried plants from Nepal on loan to the Department of Botany The flora of Nepal is very little known, for only a small area has been explored botanically The Friends of the National Libraries, with the co operation of one of their members, Mr Basil H Soulsby, have presented to the Library a copy of Robert John Thornton's rare work "Botanical Extracts, or the Philosophy of Botany", in four volumes (London, 1798–1810) Dr Thornton (1768–1837), a distinguished member of Guy's Hospital, spent many thousand of pounds on producing botanical works, and in 1811 Parliament sanctioned the Royal Botanical Lottery, to which the Prince Regent gave his patronage

THE general subject of the International Industrial Relations Congress to be held at Amsterdam on Aug 23-29, is announced as "Social Economic Planning—The Necessity for a Planned Adjustment of Productive Capacity and Standards of Living" The main object of the conference is the integration of the economic and political factors responsible for the maladjustment which causes so much unemployment in the midst of economic progress Such resolution of the disturbing factors is essential to political and economic co-operation in the planning and adoption of development policies in production and standards of living if policies are to be based on economic facts The programme includes addresses on the "Significance of World-wide Unemployment", by Dr Max Lazard, Paris, "Recent Growth in the World's Productive Capacity", by Dr Otto Newath, Vienna, "The Problem of Planned Economy", by Dr L Lorwin, Washington, "Principles and Practice of Scientific Management", by Dr H S Person, New York, and H von Haan, Geneva, "Experience and Potentialities in International Economic Treaties", by Prof J. P Chamberlain, New York, "International Planning by Industries", by

Prof M J Bonn, Berlin, "Mass Distribution and Standards of Living", by E A Filene, Boston, U S A, and "International Agreement on Labour Standards", by M Albert Thomas These addresses will be followed by discussions, and other discussions are announced on "Potentialities in National Economic Planning", "The Co operative Movement", "The International Bank Its Potential Relation to Planned Production", and "The Economic Basis of Regional Agreements"

The Advisory Committee on the Welfare of the Blind has issued its ninth *Report*, 1930, to the Minister of Health (H M Stationery Office, 1931 6*d* net) It is estimated that the blind population of England and Wales on Mar 31, 1930, numbered 56,853 Attention is directed to an experiment in sub contracting for the manufacture of 'forms' for telephone bell sets by blind persons There were no complaints as to the quality of the work, and the output was satisfactory, averaging two thirds that of sighted workers The experiment confirms conclusions already reached by psychological analysis, namely, that skill in executing a movement depends both upon a muscular control which is independent of vision and a visual control, and totally blind persons must always suffer a handi cap in this respect

At the end of last year, Prof A A Ivanoff retired from the position of Director of the Observatory in Pulkovo and took over the office of the President Adjoint of the Central Chamber of Weights and Measures (Leningrad, Mezhdunarodny Prosp, 19)

The following have been proposed for election as honorary members of the German Chemical Society A Angeli (Florence), E J Cohen (Utrecht), W Ipatiew (Leningrad), I Langmuir (Schenectady), H Le Chatelier (Paris), Sir William Pope (Cambridge), The Svedberg (Upsala), E Warburg (Berlin)

The following have been elected as officers of the Physical Society of London for 1931-32 *President* Sir Arthur Eddington, *Secretaries* Dr Ezer Griffiths and Dr Allan Ferguson, *Foreign Secretary* Prof O W Richardson *Treasurer* Mr R S Whipple, *Librarian* Mr J H Brinkworth, *Assistant Secretary* Dr J J Hedges, *Editor* Capt C W Hume

The council of the Royal Geographical Society has made the following awards for 1931 The Murchison Grant to Mr L M Nesbitt, for his difficult journey through the Danakil country of Abyssinia, The Back Grant to Col R H Rowe, for his surveys in Nigeria and on the Gold Coast, The Cuthbert Peek Grant to Mr H J L Beadnell, for his explorations in the Libyan Desert, The Gill Memorial to Mr Michael Spender, for his studies of the Great Barrier Reef

A series of lectures, the first under the terms of the Heath Clark bequest to the University of London, will be given on May 4, 5, 6, 7, and 8, in the London School of Hygiene and Tropical Medicine, Gower Street, by Sir George Newman, the Chief Medical Officer of the Ministry of Health and the Board of Education, who has taken as his subject "The Rise of Preventive Medicine" All the lectures commence at five o'clock and are open to the public without ticket

A course of advanced lectures in sociology will be given by Prof E Westermarck at the London School of Economics on May 6, 7, and 8, the subject of the lectures being "Pagan Survivals in Mahommedan Civilisation" The first lecture will cover the beliefs in the jinn, the evil eye, and the curse In the second, Prof Westermarck will deal with the conception of holiness and the closely related beliefs connected with saintly persons, places, and objects In the third lecture he will cover Roman and pagan survivals in Mohammedan ritual Prof C G Seligman will take the chair at the first lecture The lectures will begin at 5 P M, and admission will be free to students and others interested

The thirty sixth general meeting of the Deutsche Bunsen Gesellschaft will be held at Vienna on May 25-28 next The programme includes a list of thirty papers on various branches of pure and applied physical chemistry and a number of excursions and visits to places of interest The titles of the separate lectures show that a wide field of interest both in pure and applied science is to be offered at the meeting The subjects to be discussed include metallography, crystal structure, thermodynamics, spectroscopy, adsorption, and free radicals, and many well-known authorities will take part in the programme The arrangements made for the accommodation of visitors from overseas and for excursions are complete, and the meeting promises to be one of great interest

An invitation is again extended to farmers' and farm workers' associations and clubs chambers of agriculture and horticulture, students' societies, and other bodies interested in agriculture or market gardening to inspect the Rothamsted and Woburn Experimental Plots during the coming summer Mr H V Garner and Capt E H Gregory will be available to demonstrate the plots At Rothamsted the soil is heavy and the experiments deal with the manuring of arable crops and rotation experiments At Woburn the soil is light and the experiments are concerned more particularly with the manuring of potatoes, sugar beet malting barley, wheat, and the use of green manures All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden

Applications are invited for the following appointments, on or before the dates mentioned —A lecturer in mechanical engineering at the Handsworth Technical College—The Principal, Handsworth Technical College, Handsworth, Birmingham (May 11) A half time lecturer in social economics and tutor academic work in the Department of Social Study the University of Birmingham—The Secretary, The University, Birmingham (May 13) A Bayliss Starling scholar at University College, London—The Secretary, University College, Gower Street, W

(May 15) A research student in experimental physics in the Henry Herbert Wills Physics Laboratory of the University of Bristol—Prof A M Tyndall, The University, Bristol (May 18) Lecturers on, respectively, economics and industrial organisation at the School of Economics and Commerce, Dundee—The Principal, School of Economics and Commerce, Dundee (May 23) Two senior and four junior research scholars at the School of Economics and Commerce, Dundee—The Principal, School of Economics and Commerce, Dundee (May 23) An assistant lecturer in mathematics in the University College of Hull—The Registrar, University College, Hull (May 29) Two tutors for extra mural education in rural areas, under the Joint Committee of the University of Birmingham and the Workers' Educational Association—The Director of Extra Mural Studies, The University, Birmingham (May 30) A Sir Clement Royds memorial scholar in chemistry in the University of Manchester—The Registrar, The University, Manchester (June 1) Instructor lieutenants in the Royal Navy, with university training and an honours degree in mathematics, science or engineering—The Adviser on Education, Admiralty, S W 1

Our Astronomical Column

The Expansion of the Universe —Sir Arthur Eddington contributes a letter to the April number of the *Observatory*, in which he answers some questions submitted by Mr B M Peek The expansion is relative to our ordinary standards of length, for example, the wave length of the red cadmium line may be taken as our standard Secondly, the expansion is modified by gravitational action Where there is periodic motion, as in the planetary system the only effect of the expanding tendency is to lengthen the period corresponding to a given distance from the centre This would be the case also in the rotation of the galaxy He differs from Prof de Sitter, who thinks that the expansion would be effective even in these cases It is only when we come to the large scale of intergalactic distances that the expansive tendency prevails over the attractions of the galaxies on each other and periodic motion is no longer possible He says that the problem may also be treated on the basis of taking the radius of space as constant, and our standards of length and time as shrinking This assumption leads to the anomaly that an infinite number of terrestrial years would have a finite sum, and all matter would disappear in a finite time Thus he prefers the "expansion of the universe" to the "contraction of the atom"

Collision Theory of Novæ —The March number of *Scientia* contains an article on novæ by A C Gifford, of the Dominion Observatory, Wellington, New Zealand He examines the various theories current on the subject, such as collision of star with nebula or with a body of planetary size, but expresses his strong preference for the theory of collision of star with star, advocated so persistently by the late Prof Bickerton The main difficulty of this theory is that, on the average, novæ appear more often than once a year (including telescopic ones), and that examination of the density of star distribution indicates that collisions between them would be extremely rare Also, one might expect to see the stars separately, some years after the outburst, but this has not been reported, the appearance in Nova Pictoris after the outburst did not suggest two stars The theory that the outburst may result from some instability in the star's interior is now gaining favour, but is not noticed by Mr Gifford, nor does he notice the modification of the theory of collision with nebulæ, namely, that this might produce a blanketing effect, causing the star's heat to be bottled up, ultimately leading to an explosion

Comets —Publication No 74 of Copenhagen Observatory gives the following definitive orbit of the periodic comet 1927 III = 1926 *f* (Comas Sola) by J M Vinter Hansen 199 observations are used, extending from Nov 4, 1926, to May 31, 1927 Perturbations by Jupiter and Saturn are applied The question of possible identity with Spitaler's comet (1890 VII) is not dealt with, this depends so much on the exact circumstances of the approach to Jupiter in 1912 that it is better to wait until the next return of the comet in 1935, when the period will be known with exactness The date of osculation is 1926 Nov 30 0

The orbit of comet 1930 *d* (Schwassmann Wachmann) is by Jorge Bobone of Cordoba, using observations from May 2 to July 8 (*Astr Jour*) The elements of comet Pons Winnecke for the 1927 apparition (by B Strömgren) are given for comparison It appears likely that the two comets had a common origin

Comet	1927 III	1927 VII (Pons Win)	1930 *d*
T	1927 Mar 22 1029	1927 Jun 21 064	1930 Jun 14 1756
ω	38 27 50 8″	170 22 35″	192° 18 39 0″
Ω	65 35 41 0	98 8 34	76 48 31 9
i	13 45 43 3	18 56 26	17 29 30 0
ϕ	35 6 26 4	43 17 0	42 46 16 5
log q	0 0452093	0 016698	0 004935
Period	8 52004	6 00054	5 5954
Equinox	1925 0	1927 0	1930 0

T is given in U T The period of 1927 III is in Julian years It will be seen that the longitudes of perihelion of the last two comets (that is $\omega+\Omega$) are nearly identical

Ancient Egyptian Astronomy —Mme Flammarion, who has been travelling in Egypt, contributes an illustrated article to the February number of *L'Astronomie* She notes that the crescent is often associated with the goddess Hathor, corresponding to Venus, and conjectures that Venus may have been seen as a crescent in Egypt The same conclusion has been drawn from the name Ashteroth Qarnayim (Astarte of the two horns), which also corresponded to Venus She reproduces a photograph of the well of Eratosthenes at Assuan and describes the determination of the circumference of the earth which he made with its aid It is pointed out that in the time of Eratosthenes the well was 21′ north of the tropic of Cancer, but it may have been made many centuries earlier, when the obliquity of the ecliptic was greater The article states that, according to an ancient tradition, the sun completely lit up the well of Syene at the solstice This would have been the case about 3000 B C, the date usually assigned to the pyramids A picture of the temple of Denderah shows the winged solar disc, which has been plausibly conjectured to have been suggested by the aspect of the corona, especially at sunspot minimum The article combines ancient with modern by giving a picture of Helwan Observatory, and another of a battery of telescopes set up by astronomical tourists on the terrace of the Winter Palace at Luxor

Research Items.

Excavations in British Honduras, 1930.—The season's work of the British Museum Expedition to excavate Maya ruins in British Honduras in 1930 was planned to cover (1) excavation on the masonry and terrace complex at Pusilha; (2) a survey of the new site and the remains of the prehistoric bridge on the other side of the river; and (3) to bring back the two monolithic stelæ which it had been impossible to remove in the previous season. Capt. F. L. Gruning's report on the season's work is published in the *Journal* of the Royal Anthropological Institute, vol. 60, pt. 2. Owing to exceptional rains, the work of excavation and transport was much hindered, and it was possible to bring back to England only one of the stelæ. The terrace site was generally explored. Owing to lack of time, it was not possible to explore an interesting structure resembling two thirds of a pyramid which was discovered, but a substructure on terrace 3 was excavated and produced some remarkable finely flaked flints, some of which are in the form of snakes and scorpions, and a number of jadeite beads. A carved plaque or pendant, of jadeite from an excavation south of the river, was engraved with a design which the author calls the 'begging jaguar with a glyph head.' This, it is believed, is unique. One of the jadeite beads has a 'turk's head' engraving and recessed cavities for inlay. Remarkable also are certain double shells (of the *Spondylus* genus) which had evidently been imported from the coast and had been buried with the owner. They contained small personal ornaments and had evidently been used as jewel boxes. Among the contents of one was a semicircular pendant of jadeite and blister pearls pierced for suspension.

The Mesolithic Human Remains from Mugem.—In *L'Anthropologie*, vol. 40, No. 4, Dr. Henri V. Vallois reports on an examination of the skeletal remains from the kitchen middens at Mugem, Portugal. Previous accounts of this material have been confined to the remains of a few individuals. These have been re-examined, and all other specimens available have also been measured. All the skeletons here considered come from two middens only, those from the third evidently being of more recent date. The conclusions drawn require certain modifications in the views put forward by previous writers. Although female skulls are certainly more numerous, they are not double the number of the males as stated by Paula; nor do they show the number of aged individuals claimed, although a considerable number had attained years of maturity, say from thirty to fifty years of age. It has generally been agreed that the skulls include both dolichocephals and brachycephals, but this also requires qualification. The mean cephalic index of the dolichocephals is 70·9. Though high, the skulls do not show the tendency to hypsistenocephaly claimed by Mendes Correa. The face is mesoprosopic, mesorhine, and mesognathous. Dental caries is present. Of the brachycephals, which are much less numerous than the dolichocephals, it may be said that their condition does not allow any certain conclusion; they are much deformed, and in such a way as to increase the transverse diameter. Of seven skulls, four without question are mesocephalic; and question arises whether the brachycephalic race of Mugem, of which much has been written, is really brachycephalic. The question must be regarded as open, pending further discoveries, and in future we should speak of the mesocephalic rather than the brachycephalic type of Mugem. The various theories put forward as to the affinities of the dolichocephalic type are unsound. It is probably nearest to Cro-Magnon.

Pictures of Some Abyssinian Birds and Mammals.—Artistic pictures of birds at the same time accurate enough to satisfy the ornithologist, are rare; and therefore the album of coloured reproductions of thirty-two paintings, a *Special Publication* of the Field Museum of Natural History, Chicago, is an unusual treat. It contains twenty-eight pictures of Abyssinian birds and four of mammals, from paintings by the late Louis Agassiz Fuertes. The writer watched with interest the rapid progress of Fuertes' work, from his first rather crude pictures of American birds to the fine finish which he attained, and these Abyssinian pictures mark the summit, as they unfortunately mark the close, of his artistic work. No expense has been spared in creating exact reproductions, and eight and sometimes nine colours have been used in the 'offset' lithographic process. The brightness of the colours and the interest of the forms seized upon by the artist give real charm to the collection, which is published through the generosity of Mr. C. Suydam Cutting.

Growth in the Hermit Crab.—The hermit crab provides opportunities for the study of growth potentials associated with asymmetry, here seen in the larger size of the right thoracic limbs, the right-handed twist of the abdomen, and the strong heterogonic growth of the male right chela. The results of measurements on 56 male and 64 female *Eupagurus prideauxi* are given by S. F. Bush (*W. Roux Archiv f. Entwicklungs-mechanik*, 123-1, pp. 39-79). In the absolute size of the limbs, predominance of the right side is greatest in the chela. Posteriorly it grades over into left predominance starting at the fifth pereiopod in the male, and the fourth in the female. The females throughout show less right predominance. The limbs do not all grow at the same rate; there is a definite gradient, which, the right chela ignored, is identical on both sides of head and first seven thoracic segments. There is a maximum at the 3rd pereiopod, from which point, both anteriorly and posteriorly, the growth rate diminishes in a graded series. In the male the gradient is most marked. Here the chela and following two pereiopods are positively heterogonic, the right chela to an exceptional extent. The latter, though breaking the regular gradient on the right side, does not influence the growth rates of the limbs on either side of it. If the chela exerts any influence on neighbouring limbs, it is in the matter of absolute size, and it is noteworthy that right predominance is greater in the limbs immediately posterior to it than in those anterior. Comparison of males and females shows male predominance, which is greater on the right side and increases during growth, from the 1st antenna to the 4th pereiopod, grading into female predominance anteriorly (eye stalks) and posteriorly. This gradient also has its summit at pereiopod 3, and is broken on the right side by the great predominance of the ch[e]... The growth gradient within the chela is the same... that within the other pereiopods at first, but... centre shifts with increased growth.

On Unsegmented Ova of Echidna.—T. Thoms... Flynn (*Quart. Jour. Micr. Sci.*, vol. 74, part ... 1930) describes two unsegmented intra-uterine o... of *Echidna*. The egg is about 4 mm. in diameter a... has a delicate transparent shell, a thin layer o... albumen, and then the white yolk mass (with th... germinal disc on one side) enclosed in the very th... zona. In each egg, the two polar bodies had be... formed. They are smaller than those described ... *Ornithorhynchus*, and the first polar body is mu... larger than the second and, contrary to what has b... reported for *Ornithorhynchus*, remains undivided.

the second egg the two germ nuclei—one slightly larger than the other—were closely apposed preparatory to the formation of the first cleavage spindle

Inheritance of Mutual Aversion in an Ascomycete.—A further study of the mutual aversion which occurs between the mycelia derived from different spores of the Ascomycete *Diaporthe perniciosa* has been made by Miss D. M. Cayley (*Jour. Genet.*, vol. 24, No. 1), who also reviews the occurrence of this phenomenon in other fungi and its relation to the various forms of heterothallism. She adopts the nomenclature of Correns, in which the simple form of heterothallic condition due to + and − strains is called haplo heteroecious, and classifies five different types of heterothallism in the fungi. From extensive single spore cultures of *Diaporthe* and testing the reactions of the resulting mycelia, she finds that this fungus shows in addition to the ordinary sex heterothallism, a physiological heterothallism based on inter-racial and self sterility factors which influence the sexual affinity of the haplonts but segregate in ascospore formation independently of sex. The capacity for mutual aversion is thus inherited and occurs in two forms: (1) inter-racial, (2) intra-perithecial as shown by the haplo heteroecious form only. The former is a kind of sterility between biological races, the latter a form of physiological self sterility independent of sex. Aversion is marked by a line where two mycelia meet and refuse to intermingle, and the two types of aversion are not visibly distinguishable. Four ascospore generations were grown from a particular pycnospore culture, the results being stated in a factorial scheme. It is found that different asci of the same perithecium can give different types of segregation of the self sterility factors, and that the progeny of a single perithecium may or may not show aversion, dependent upon the type of segregation which has occurred in the formation of the ascospores. Mono-ascospore cultures will not form perithecia and some mycelia can throw mycelia of the opposite (aversive) group. Incidentally, the use of the term archegonium for the female sex organ of a thallophyte is to be deprecated.

Nucleoli of Rice Varieties.—A cytological study of five varieties of rice from Japan, India, Java and Egypt has been made by A. G. Selim (*Cytologia*, vol. 2, No. 1), who finds interesting differences in the nucleoli of various forms. All the varieties have the same number of chromosomes ($n = 12$) and the same size of nuclei, but the nucleoli in the resting stage of the pollen mother cells show constant differences in average size. In the variety having the largest nucleolus, it regularly divides before synizesis into two of equal size. In the next variety, a smaller nucleolus is budded off from the primary one; in the third variety division takes place later (after synizesis), while two other varieties having the smallest nucleoli, usually remain undivided. The nucleolus which is budded off from the primary one remains attached ..., but disappears earlier in the prophase than the ...r, and is believed to contain chromatin which ...ntributed to the chromosomes. It is suggested ... this secondary nucleolus corresponds with the ...eolar body found in *Lathyrus* and other forms. ...lar observations are included on meiosis in the ...aspore mother cells. This is the first case in which ...eties having the same chromosome content are ...nd to be differentiated by the character of their ...eoli. These differences are correlated with the ...ve and absolute size of the single nucleolus ...ent before meiosis begins. The work also con... other evidence that the nucleolus of plant cells ...ins two different substances.

Fossil Reptilian Egg from Yorkshire.—The *Annual Report* of the Yorkshire Philosophical Society for 1930, issued Mar. 31, contains a description by Sidney Melmore of an object in the Edward Wood collection, now in the Yorkshire Museum, from the Lias of Whitby. This, from its general shape and mode of preservation, Mr. Melmore regards as probably a reptilian egg, possibly of a crocodilian. He deduces the size as 8.5 cm. by 6.0 cm. The outer layers, unfortunately, are pyritised and show no structure.

An Extinct Tasmanian Marsupial.—Prof. Wood Jones has re-examined the well-known extinct marsupial from Tasmania, *Wynyardia bassiana*. Hitherto this form has been considered as an Eocene form and as differing in many respects from any living marsupial. Wood Jones, in the *Proceedings* of the Royal Society of Tasmania, 1930, after a careful re-investigation of the original specimen, has come to a conclusion which is in direct opposition to that which has hitherto been generally accepted. More recent research has shown that the beds from which the fossil came are much later than the Eocene and are probably late Miocene or even Pliocene. The animal itself has no character that distinguishes it from modern marsupials and many that ally it to the living genus *Trichosurus*.

Comparative Study of Soil-Profiles.—Under this title a note on an important investigation of soil profiles in Holland and Java (*Mitt. Geol. Inst. Landbouwhoogeschool in Wageningen, Holland*, No. 16, 1930) was published in these columns on Feb. 7, p. 214. Unfortunately, it was erroneously stated that the authors were A. te Wechel, L. Moser, and C. van Aggelen, whereas actually the study was made by J. van Baren, with the co-operation of the three collaborators already named. The writer of the note regrets that Dr. van Baren's name was inadvertently omitted and welcomes this opportunity of making amends to the senior author of the paper concerned.

Effect of Soil Temperatures on Subterranean Insect Fauna.—An account of experiments on winter soil temperatures at Minnesota and their relation to subterranean insect survival has been given by G. Allen Mail (*Jour. Agric. Res.*, **41**, p. 571). A thermocouple method was used for recording the temperatures at 2 inch intervals for a depth of 2 feet of soil under varying conditions, and although the insulating effect of a snow layer has long been recognised, the differences found between temperatures of snow-covered and bare ground were extraordinarily large. In the case of cleared areas, the soil temperatures showed sharp fluctuations, closely following those of the air, and a spread of 12.48° C. was found between the upper and lower layers investigated. The temperature of the snow-covered soil, however, remained much more constant and showed only a spread of 3.5° C. over the 2 feet depth. From laboratory investigations the freezing-points of adults and larvæ of *Melanotus communis* (a species of wireworm) were found to be −13° C. and −15° C. respectively. They would thus be able to withstand Minnesota winter conditions if hibernating below 4 in. from the surface, and experiments where two species of wireworm were buried in outdoor cages at depths ranging from 2 in. to 24 in. supported this view, there being practically no mortality, as the temperatures did not fall below this point. White grubs (chafer larvæ), on the other hand, are much less cold resistant than wireworms and would have to hibernate at much greater depth, below 2 ft., to overwinter successfully. Climatic conditions, may, therefore, be of great importance in insect control. Since wireworm

larvæ are active only in summer and become dormant in winter, a sudden prolonged drop in temperature would probably prove fatal, as the larvæ might be caught too near the surface of the soil Further, since rain was found to destroy the temperature gradient between the different layers of soil, a sudden drop in temperature following such conditions might also bring about a high mortality To some extent, therefore, it might be possible to forecast the severity of wireworm attack according to the previous winter conditions

Quantum Theory of Nuclei In an article in the April number of *Science Progress*, on new aspects of radioactivity, Dr C D Ellis has stated very clearly two β ray problems which still remain to be explained on the wave mechanics The first is that of the distribution of energy amongst the β particles which arise from the disintegration of the nucleus itself, these have both a continuous 'velocity spectrum' and an upper limit to the energy which is at best so indefinite that Dr Ellis concludes that this type of disintegration can occur with an emission of a particle of any energy whatever The whole process appears to take place in some way governed by essentially statistical laws, as in Maxwell's gas theory, but fundamental difficulties arise in that the corresponding fluctuations must occur within a single nucleus, that is, within a volume comparable with that of the electron when it is considered as a particle, and that the peculiarities of this space must be conditioned largely by the movement of the electron The second difficulty is that far more energy which could appear in the form of γ radiation is converted into a corpuscular β radiation within the parent atom than would be expected The difficulty persists even when two modes of transfer of energy into the corpuscular type are allowed for, namely, formation of a γ ray which leaves the nucleus and is converted photoelectrically before it can pass out from amongst the orbital electrons of the same atom, and the assumption of the energy of an excited nucleus, before a γ ray has been formed at all, as the result of a collision made by one of the orbital electrons of the atom in passing through the nucleus No satisfactory solution of either of these problems has yet been proposed, and it remains an open question whether or not they are capable of explanation on the present theories

Pine Resins —A valuable paper upon the resins of the jack pine (*Pinus Banksiana*) appears in the *Canadian Journal of Research*, **4**, pp 1 34, 1931, by Harold Hibbert and John Bernard Phillips The authors examine the methods previously used for the separation of the various constituents from the resin and decide upon a modified procedure in which the resin, originally extracted from the wood by an alcohol benzene mixture, is extracted with ether, and the water insoluble substances in the ether extract later extracted with 5 per cent sodium carbonate, the residue being then subjected to steam distillation Resin acids and fatty acids in the alkaline extract are freed by addition of acetic acid, and are then separated by esterification of the fatty acids by ethyl alcohol and sulphuric acid Steam distillation has yielded a volatile essential oil and a non volatile residue which is saponified and thus separated into fatty acids and non-saponifiable matter The resins of fresh and seasoned timber were compared, the changes in the resin during seasoning appear to be due to oxidation and polymerisation of the unsaturated fatty products and to changes in the resin acids The authors also direct attention to the tendency of the easily polymerisable terpenic products present to yield products of a sticky, tacky nature

The Quinhydrone Electrode —The use of the quinhydrone electrode, discovered by Haber and Russ in 1904, has been considerable since its development by Granger and Nelson and by Bilmann, independently in 1921 The conditions for the reproducibility of th electrode and its value compared with the calomel electrode were published by Bilmann and Jensen in 1927, and now two important papers by Morgan, Lammert, and Campbell have been published in the February issue of the *Journal of the American Chemical Society*, which contain numerous practical details on the use of the quinhydrone electrode In the first paper, the method of setting up and of cleaning the metal part of the electrode are discussed, and the influence of the nature of the metal used Platinum and platinum alloys gave better results than gold, the age of the platinum was of little importance if th electrode was large enough Very small short wire gave erratic results, larger short wires gave consistent results but larger deviations than foils longer lengths of wire Two foils with dimensions larger than 1 sq cm gave differences of potential when measured against one another, of less than 0 000010 volt The second paper deals with the effect of excluding oxygen from the solution and the use of nitrogen in the electrode Quinhydrone electrodes prepared with nitrogen were found to be far more reproducible than those used in air, and the quinhydrone electrode prepared with chemically pure platinum dipping into 0 1 *N* HCl saturated with quinhydrone and stirred with nitrogen was found to be more easily reproduced with great precision than any other half-cell used for reference Gold was less satisfactory than platinum Irregularities in unshorted electrodes, which occur in air, disappear in nitrogen Whereas cells composed of air dried electrodes and mechanically stirred solutions may take an hour to reach equilibrium and unstirred solutions longer, cells with nitrogen stirred solutions take up equilibrium values almost immediately The electrodes need not be dried in nitrogen, if this gas is bubbled through the solution

Hardening of Metals by Rotating Magnetic Fields —E G Herbert has already shown that work hardened metals become still harder when they are subjected to the influence of a rotating magnetic field In a recent paper (*Proc Roy Soc*, A 130, 154) the research is extended to include alloys which are susceptible to age hardening, and a similar effect has been observed By the combined use of ageing, magnetic field, and cold work, the hardness of a 0 8 per cent carbon steel has been increased from 715 immediately after hardening to 1080, whilst a high speed steel has been hardened from 700 to 1000 Brinell The effects observed are extremely complex, and at times temporary or permanent softening results The influence of these alternating magnetic fields is confined to magnetic materials Duralumin sh quite analogous effects and the alloy may be ' hardened' by magnetic means to a distinctly hi degree than is normally possible Even brass sh effects of the order of about six per cent Altho high frequency fields and very rapid rotation of specimen have been tried, it is shown that neithe necessary, an equally marked effect being produ by slowly rotating the specimen for a few seco across the poles of a powerful electro magnet temperature at which the treatment is given appe to have considerable influence on the degree hardening, this being greater for a hard steel 100° C than at room temperatures It is pointed that the process could be applied with ease to t such as drills, milling cutters, dies, etc, howe complicated their shape

Cotton-growing in the British Empire *

THE work undertaken during the year 1929–30 by officers of the Empire Cotton Growing Corporation stationed in the various cotton producing countries of the Empire is summarised in the report now before us Following the lines of the similar reports issued in preceding years, with which it requires to be read, the volume is a record of steady progress

The outstanding feature of the year is the continued success of the Barberton selections of Jassid resistant strains of cotton This success is not limited to South Africa, where it has given a new lease of life to an industry threatened with extinction through the depredations of the insect, it extends through a wide tract of country embracing the whole of East Africa as far as Uganda, and even into the Sudan Though in the latter country U4, the main resistant race did not show up well under irrigation, of the cottons grown it proved itself one of the most resistant to leaf curl Being itself a preliminary selection as yet unstabilised in respect of many characters of economic importance it promises to become, by selection or hybridisation, the parent of numerous strains adapted to one or other of the varied conditions which naturally occur through so wide a stretch of country In South Africa itself selections from U4 are being crossed with Cambodia certain selections from which have proved to be even more Jassid resistant than the original U4

Of the impressions which a perusal of the various reports leaves on the mind, perhaps the most lasting is concerned with the manner in which local conditions force into prominence different aspects of the problem which the organisation has set itself to solve In South Africa the primary problem was concerned with Jassid for on that solution the life of the industry depended With the solution of that problem other aspects are assuming prominence Cotton is here one of a series of crops, it occupies no dominant position Its setting in the rotation is receiving growing attention and progress is recorded in the investigation of that interesting problem of the harmful effect of a preceding fallow In the two Rhodesias if the work at Barberton has removed one danger and provided in U4 a basis for remunerative cultivation, other dangers exist and in the cotton stainer and the boll worm the insect world exercises a dominating position In Nyasaland, soil problems are engaging attention especially in relation to root development In Uganda the varietal question predominates

In that complex area the Sudan the question of staple assumes importance in those areas, like the Gezira in which the Egyptian type of cotton is grown, and much attention is devoted to spinning tests The appearance of leaf curl during the last few years has introduced a new threat into these tracts which has to be met within the group of cottons yielding that class of fibre and here resistant strains of Sea Island afford a promising basis for progress It is of interest to note the suggestion that this resistance may be the result of a capacity to form an adequate root system, for there is in this suggestion further evidence of a growing recognition of the need both for a better knowledge of root systems in general and for a deeper search for the basis of resistance either in morphological character or in physiological reaction While there is still much to learn with respect to the transmission of the disease its development appears to depend in large measure on the capacity of the root system to make use of the particular soil in which the plant is growing

The potentialities of the rain area in the Southern Sudan are being explored and the work as is natural in a country lacking an indigenous system is mainly concerned with variety trials and dates of sowing The necessity of early sowing is clearly demonstrated

* Empire Cotton Growing Corporation Reports received from Experiment Stations 1929–30 Pp xi + 342 (London Empire Cotton Growing Corporation 1931) 2s 6d

History of the Fauna and Flora of the British Isles

THE British Isles with their comparatively small area but considerably varied natural conditions present a number of highly interesting biogeographical problems, the solution of which would bear an important relation to the larger problems of the distribution of organisms in Europe and in the northern hemisphere generally It is not surprising therefore, that the French Société de Biogéographie should have selected the history of the fauna and flora of the British Isles as a subject for its new volume * the third of a series devoted each to the treatment of a separate biogeographical problem, the two previous volumes dealt with the biogeography of Corsica and of the high mountains of the world respectively

The volume represents a collection of papers by ten different authors, writing in French or in English, and each dealing with his special group of organisms in his own way An introductory article, by L Joleaud, on the palæogeographical history of the British Isles, is followed by a paper on mammals, by Mr Heim de Balsac, who discusses not only the recent fauna, but also summarises the post glacial palæontological evidence One of his general conclusions is that the history of the British fauna is in many respects different from that of the European fauna, particularly with regard to the effects of the glacial period, which were considerably less serious in the British Isles owing to their milder oceanic climate The next article by the same author deals with British birds and emphasises the high percentage amongst them of endemic races as well as the presence of certain Mediterranean elements

The spider fauna of the British Isles is analysed by W S Bristowe who divides the country into five zones limited mainly by temperature conditions With regard to the history of the spider fauna, Mr Bristowe believes it to be relatively simple and appears to derive it directly from the continent after the original fauna had been exterminated by glaciation A great portion of his article is devoted to the discussion of a general problem of the aerial migration of spiders as a factor in populating island areas

A full list of British Orthoptera includes only 36 species 10 of them being introduced through human agency The affinities distribution beyond the British Isles and the probable history of each of them, is discussed by B P Uvarov Out of this number, nine species are considered to be relics of a very ancient probably Tertiary, fauna connected with humid and warm climate Another definitely preglacial group of five species, distributed mainly in the Mediterranean region is called Atlantic, and they are regarded as relics of the rich fauna of Atlantis, which continent has probably extended as far northwards

* Contribution à l'étude du peuplement des Iles Britanniques — Société de Biogéographie, 3 pp 193 (Paris P Lechevalier 1930)

as the southern coasts of Ireland and England One third of the fauna, twelve species, exhibit affinities with the present day Siberian and eastern European fauna and are considered to represent the result of an invasion of the steppe fauna originating in the Angara continent This invasion may have happened either after the last glaciation or, possibly, immediately before it

M E Mosely presents a survey of British Trichoptera but abstains from zoogeographical deductions, while stressing the importance of the ecological factors in their distribution

The Heteropteran fauna is analysed by W E China, who recognises in it the Lusitanian, or Atlantic, the American, the Arctic, and the Germanic elements, these being the groups distinguished by Scharff in his well known work on European animals Certain members of the Lusitanian group are xerothermic in their ecological requirements, but their present distribution elsewhere makes it highly probable that they have survived through the glacial periods on the spot, in sheltered situations Most of the species of the American group should be properly referred to the Angara fauna, to which the larger portion of the Germanic group also belongs, but there are species occurring only in America and in western Europe, including the British Isles but not in Russia or Siberia Definite relationship to the American fauna is also shown in the Arctic group Insular variations in British Heteroptera are unimportant and few in number Out of six endemic species, three are doubtful, while the remaining three are probably Atlantic relics

A brief review of British Lepidoptera, by L Dupont, stresses the poverty of the British fauna and the presence of a considerable number of local forms, many of them being melanistic No zoogeographical analysis is attempted by this author

A discussion of the beetle fauna, by J Sainte-Claire Deville, one of the best authorities on the zoogeography of European Coleoptera, is highly interesting and instructive, being illustrated by a series of twenty four distributional maps One of the main conclusions of this author is that there are no sufficient reasons to believe that the Quaternary glaciation exterminated the original fauna On the contrary, a number of species of southern origin (Mediterranean) have certainly survived the glaciation

The last two articles of the volume deal with the flora J Cardot discusses the mosses, and reveals the interesting fact that there is a very close relationshi[p] between the bryophyte flora of the British Isles an[d] that of the Atlantic islands (Canaries, Madeira, a[nd] Azores) There are even several species which do n[ot] occur elsewhere, while certain species occur besid[e] in the subtropics only The author, however, attr[i]butes their appearance in the British Isles to th[e] distribution of spores by air, after the Quaterna[ry] glaciation, which in his opinion has wiped out a[ll] mosses except some boreal species

A J Wilmott in his thorough analysis of the Britis[h] phanerogamic flora arrives at the opposite conclusion, which is based on a critical discussion of geological facts and theories, of the evidence derived from the study of the Quaternary fossil plants, and of the present distribution of floristic elements He believes that the climate of the glacial periods could not have been so severe as to exterminate the original flora completely, and there is every reason to think that the relatively mild and humid climate of Atlantic type prevailed at least in some sheltered situations of the south west of Ireland and England, thus permitting the survival of aboriginal plants As we have seen, this conclusion agrees well with the opinions of the majority of the contributors to this interesting volume

The Name of Mount Everest

MOUNT EVEREST was first observed by the Survey of India in 1849, but it was not until three years later that its great height was realised From the plains of India it is only one among many conspicuous peaks, and its distance from the Indian frontier across the whole width of Nepal often prevents its being seen at all In these circumstances, it was not surprising to find that there was no Indian name for the peak The first names proposed were the Nepalese names Devadhunga and Gaurisankar The first, however, was found to be non existent as a peak name in Nepal, and the second belongs to another peak There was no entry of the surveyors into Tibet in those days, and, in the lack of Indian and Nepalese names it was necessary to find a title for the peak This was done in 1865 by naming it after Sir George Everest, of the Trigonometrical Survey of India

The controversy about the name was discussed by Major S G Burrard in NATURE,[1] and is now reopened by Dr Sven Hedin in his recent German book on Mount Everest Sir Sidney Burrard replies to these suggestions in a paper recently issued by the Survey of India[2] Dr Hedin maintains that the mountain was first shown on D'Anville's map of Tibet published in Paris in 1733 This was based on a survey made between 1711 and 1717 by Chinese lamas instructed by Jesuits in Peking and was until about a century ago the only map of Tibet The identification of Mount Everest on this map is very doubtful A range of great heights is shown at right angles to the actual alignment of the peaks of the region Located in terms of the river valleys, which the lamas portrayed more accurately than the mountains, this range is forty miles distant from Mount Everest Moreover there is no indication that the lamas were aware of an exceptionally high peak in that region Thus, there are no grounds for using the lamas' name of Chomo Lungma for Mount Everest, as Dr Hedin suggests

Attempts to discover a Tibetan name for the mountain have resulted in five names being found Each has merely local use and not one has any general acceptance although the mountain is a conspicuous feature from several parts of Tibet One of these names is certainly Chomo Lungma, but it would appear to have restricted use and to be applied to both Everest and Makalu in fact, it is applied to an area rather than a peak

In these circumstances, there is no justification for displacing the name of Everest It has always been the practice of the Survey of India to use local names when these have been in existence Everest is probably the only departure from this principle but it is a departure that was unavoidable Even if a Tibetan name in general use were revealed, it would be of doubtful value to replace a name that has no[w] become universally known and accepted No po[s]sible benefit could result from such a change

[1] NATURE Nov 10, 1904

[2] Survey of India Professional Paper No 26 Mount Everest a[nd] its Tibetan Names a Review of Sir Sven Hedin's Book By Col S[ir] Sidney Burrard Pp ii+18 (Dehra Dun Survey of India, 19[31]) 8 annas, 10d

Research at the Mellon Institute during 1930-31

IN his eighteenth annual report to the board of trustees of the Mellon Institute, Pittsburgh, the director, Dr E R Weidlein, has summarised the activities of the institution during the fiscal year ended Feb 28, 1931 The sum of about £160,000 was contributed to the Institute by the industrial fellowship donors in support of scientific research The total amount of money appropriated by companies and associations to the Institute for the twenty years ended Feb 28, 1931, was £1,511,000

Throughout the entire fiscal year 76 industrial fellowships—22 multiple fellowships and 54 individual fellowships—were in operation During the preceding year the number of fellowships was 71 In 1930-31, 140 industrial fellows and 49 assistants held positions on the research staff Sixty four industrial fellowships (17 multiple fellowships and 47 individual fellowships)—three more than on Feb 28, 1930—were active at the close of the fiscal year Nine fellowships are being sustained by industrial associations The industrial research personnel consists of 109 fellows and 31 assistants Thirty one fellowships have been in operation for five years or more, and of this number 18 have concluded more than ten years of work Three (and possibly four) new fellowships will begin operation during the early part of the present fiscal year, as soon as laboratory space is available

According to the report, noteworthy results have developed from the following fellowships air pollution, by product coke, face brick, fertiliser, heat insulation, iodine, nitrogenous resins, organic synthesis, refractories, sleep, and utensil Twelve fellowships completed their research programmes, namely chrome ore, insulating lumber, Portland cement composite glass, yeast, inhibitor, steel treatment, rock products, roofing, fatty acids (uses), oxygen, and face brick Thirteen new fellowships were added to the Institute's roll during the fiscal year, as follows safety fuse, plastic composition, bread, cottonseed products, hydro engineering, abrasives, newsprint, fatty acids (synthesis), shoes, optical glass, commodity standards, and tyre bead

The Department of Research in Pure Chemistry had a productive year and two fellows were added to the staff Twenty two investigational reports have been published since the establishment of this department in 1924 Among the subjects that are receiving research attention are the chemistry of marine plants, cherry gum, gum arabic and quince seed mucilage, and the properties of the sugar acids

The publications by members of the Institute during the calendar year 1930 included 1 book, 5 bulletins, 45 research reports, and 44 other papers Sixteen U S patents and 13 foreign patents were issued to fellowship incumbents The total contributions to the literature for the 19 years ended Jan 1, 1931, have been as follows 16 books, 101 bulletins 573 research reports, 893 other articles and 423 U S patents These publications are listed in the Institute's *Bibliographic Bulletin* No 2 and its four supplements

The commencement of the construction of the Institute's new home is referred to as the most important event during the year covered by the report Early in May 1930 it was decided that, as the present two buildings of the institution are inadequate for the immediate and future needs of its departments and industrial fellowships, a commodious modern structure would be built at the corner of Fifth and Bellefield Avenues, Pittsburgh The excavating work, which was begun on Nov 5 was finished in March and the foundation is now being constructed

The new building, which will be completed in about two years will enable the Institute to expand greatly its research facilities and activities in both pure and applied science The structure which will be in the Ionic style will be built of granite and Indiana limestone, it will be plain but massive, and will be surrounded by 62 monolithic columns The proportions of the building will be approximately 300 ft by 275 ft, and there will be eight working floors

Hydrography of Polar Seas

IN the journal of the International Council for the Exploration of the Sea, for December 1930 (*Journal du Conseil*, vol 5 No 3, p 329), E Kreps and N Verjbinskaya of the Murman Marine Biological Station describe the results obtained on cruises made in the months of March, May, September, and December along the meridians 33° 30′ E and 38 E from the Murman shore to the ice margin The waters showed the typical cycle of the utilisation of phosphates and nitrates by the phytoplankton in the spring and summer months and their regeneration in the winter The phytoplankton was, in this research, estimated by centrifuging an aliquot part of sea water, dissolving the contained diatoms in alcohol, and determining the amount of chlorophyll present spectro photometrically

The region under survey is invaded by branches of the North Cape current of warm Atlantic drift water, the southernmost branch being the Murman current, and the Franz Joseph branch being in the north An interesting difference between the cycle of events in the cold polar waters and that in the warmer Atlantic water was brought out In May, in the cold Arctic waters, an outburst of diatom flowering had already taken place and the surface waters down to 25 metres showed a decrease in their manurial salt content, the Atlantic water, however, showed little difference in its content of these salts from the surface to the bottom and there was as yet no sign of diatom growth In September there was little difference between the Arctic and Atlantic waters, the surface layers all being depleted in phosphate and nitrate and the deeper layers rich, but the conditions of phytoplankton production were reversed, the Atlantic surface waters being now rich in chlorophyll and the Arctic waters very poor

It thus seems that the outburst of phytoplankton in the Atlantic water takes place later than in the Arctic waters The actual reasons for this afford an interesting problem In winter complete vertical mixing had taken place and the phosphates and nitrates had been enriched from the surface downwards In 1930 observations made between March 28 and April 11 showed no sign of the vernal outburst in the Arctic waters

With reference to the relative richness in nutrient salts the inshore waters were the poorest the Arctic waters the richest the Atlantic water being not so rich as the cold The maximum winter values for phosphates were in the neighbourhood of 50 60 mgm P_2O_5 per cubic metre In the same journal it is also interesting to read of phosphate estimations made in southern polar seas by Johan T Ruud (*ibid*, p 347), here in places in the Weddell Sea the readings run up to 150 mgm P_2O_5 per cubic metre at the surface

University and Educational Intelligence

CAMBRIDGE.—An election to the Sheepshanks Exhibition for proficiency in astronomy will be held in the present term. Any member of the University under the standing of master of arts or, being a research student, under the standing of doctor of philosophy may be a candidate for the exhibition. The holder of the exhibition is required to engage in astronomical research to the satisfaction of the Council of Trinity College. Candidates are invited to send in their applications, before May 6, to Prof. Stratton, Gonville and Caius College, stating their qualifications and claims and proposed course of astronomical research.

The General Board recommends (a) that a university lectureship in pharmacology be established in the faculty of medicine as from Oct. 1, 1930; (b) that a university demonstratorship be established in the Department of Experimental Psychology as from Oct. 1, 1931.

The following Syndicate has been appointed to consider the medical courses and examinations of the University and their relations to courses and examinations for the degree of B.A.: the Vice-Chancellor, Prof. H. R. Dean, Mr. W. Spens, Sir Humphry Rolleston, Dr. T. S. Hele, Dr. E. D. Adrian, Dr. A. E. Clark-Kennedy, Dr. L. A. Borradaile, Prof. J. T. Wilson, Prof. J. Barcroft, Mr. H. Thirkill, and Mr. H. McCombie.

EDINBURGH.—Members of the University Court, Senatus, and General Council and a large body of students attended on April 22, in the Old College, a memorial service to the late Prof. Lorrain Smith, professor of pathology since 1912 and dean of the faculty of medicine. The service was conducted by the dean of the faculty of divinity, Prof. Curtis; the text was read by the Vice-Chancellor, Sir Thomas Holland; and Prof. Samuel Alexander, of the University of Manchester, paid a tribute to the memory of Prof. Lorrain Smith. Representatives attended from the Universities of Belfast, Manchester, Cambridge, Glasgow, and Aberdeen.

LONDON.—Keddey Fletcher-Warr Studentships, each of the value of £250 a year for three years, have been awarded to Mr. H. W. Thompson, for a study of the chemistry of the methyl- and the chloro-naphthalines, and to Margaret Hill, for the continuation of work in progress on the regulation of the ovary, with special reference to the part played by the hormones of the anterior pituitary body.

THE fourth biennial conference of the World Federation of Education Associations will be held at Denver, Colorado, on July 27–Aug. 2. Of special interest is the health section, which is active in promoting the health of children through the schools of the world. Further information concerning the conference can be obtained from Miss S. L. Jean, 200 Fifth Avenue, New York.

AN election will shortly be made to a Bayliss-Starling Memorial Scholarship, founded by old students, friends, and admirers, in commemoration of Sir William Bayliss and Prof. E. H. Starling. The scholar will be required to follow a course of study approved by the Jodrell professor of physiology at University College, London, involving a training in the principles of, and methods of research in, physiology and biochemistry. Candidates must send their applications to the Secretary of University College not later than Friday, May 15.

A PARTY of representatives of the universities of Great Britain were the guests of the Prussian Government on April 19, at the State Opera House, Berlin. The party has been on a tour of investigation of the German university system. The tour was organised at the instance of the International Relations Committee of the Association of University Teachers. It is the second international tour that has been organised, the first having been to France in 1930. The objects in view are to collect data for a comparative study of university systems and to promote contact and co-operation between academic circles in Great Britain and other countries. Visits to Switzerland and the United States of America are in contemplation. Both in France and in Germany these visits have aroused wide and intense interest among educational authorities, who have received the parties with the greatest cordiality and have offered the fullest facilities for inquiry into every aspect of their activities. There can be little doubt that in publishing detailed reports of these investigations, the Association of University Teachers is performing an important service both to the cause of higher education, especially in regard to university development, and in furthering international understanding and goodwill, and that it may eventually result in the establishment of some permanent scheme of co-operation on the part of the universities of the world, which may create a forum for the discussion of their common problems. The Report on the French University System, based on the 1930 visit to France, may be obtained from Prof. R. Douglas Laurie, honorary general secretary of the Association of University Teachers, University College, Aberystwyth (6d.).

Birthdays and Research Centres

May 3, 1892.—Prof. G. P. THOMSON, F.R.S., professor of physics in the Imperial College of Science and Technology.

An attempt is being made by several workers at the Imperial College to use the phenomenon of electron diffraction as a tool to study the nature of surface layers, particularly those formed in the corrosion of metals. It has been proved that cathode rays, when reflected from a crystalline or microcrystalline surface of known structure, form a diffraction pattern which depends on the crystal structure just like the pattern formed by X-rays. Conversely, the pattern gives information about an unknown structure. The advantage of using electrons instead of X-rays is that the former only penetrate a few molecules deep, and so give information about the surface layer without confusion by the bulk of the solid.

May 7, 1886.—Prof. H. HARTRIDGE, F.R.S., professor of physiology at St. Bartholomew's Hospital Medical College, London.

In conjunction with Dr. Ranyard West, I have been engaged on an investigation of certain aspects of muscular tone. We have found that tetany, produced in animals by the removal of the parathyroid glands, may be temporarily relieved by the administration of the drug curare. Before giving the curare, an animal may be lying on its side with its limb muscles in tonic contraction; about half an hour after giving the curare, the animal may be running or eating in apparent normal health.

Since curare is used as an arrow-head poison for producing paralysis and death, this 'cure' of tetany is a very unexpected phenomenon. We are investigating the matter further, as we hope it may throw light not only on the mode of action of curare but also on the nature of tetany.

eties and Academies.

London

ʊgical S ɔciety, April 1 —**Bernard Smith** The ır-lakes of Eskdale, Miterdale, and Wasdale, ɔerland, and the retreat of the ice during the n Glaciation' From a review of the available ɲce in the north west of England it is concluded the Great Ice Age in Cumberland and the Irish basin comprised at least three main episodes paper is confined chiefly to the second—that of Main Glaciation' The withdrawal of the com Irish Sea and Lake District ice towards the close episode is discussed, and it is concluded that the ɩetween the two ice sheets progressed north Irish Sea ice tending to shrink on one hand s the sea basin westward and north westward, the Lake District ice—breaking up into tongues glaciers—tended to shrink north eastward and d The stages in the formation of the lakes eir deposits are described, and the positions of fronts at different times are indicated Of the s, special reference is drawn to beaches, especi ɔse fringing islands, to normal lake deltas, and ety referred to as 'scale deltas' —**Rev Joseph** The 'one hundred foot' raised beach between and Chichester Prestwich, in 1858, assumed 15 foot raised beach at Brighton is represented 00 foot raised beach west of Arundel Clement seems to accept this identification There is, ', no proof, either of (1) any differential move the general process of elevation, or (2) a fault the two ... that might account for the cy in level... Moreover, the 'rounded , cited by Prestwich as connecting the two of marine material, is almost certainly of ary age It seems safer to assume the presence wo stages of raised beach—a '100 foot' and a ot' beach Clement Reid appears really to sup his view when he is considering the different of the Selsey deposits So also, more recently, J O White Nevertheless, it must be noticed here is, apparently, no ascertained example of 00 foot beach east, or of the 15-foot west, of the Valley

oyal Meteorological Society, April 15 —**W D** er An analysis of the cold front over Egypt on 7, 1929 The usual autographic records of l, temperature, humidity, and pressure at Helio- s and Ismailia were used, with records of the cal temperature gradient at the latter station old air advanced in the form of a wedge with e above the surface of Ismailia, but as a flat on the surface at Heliopolis —**W H Pick** te on the relationship between fog and relative idity The fogs occurring at synoptic hours at ngton during the years 1929 and 1930 are ex- ied and it is shown that the majority of them accompanied by unsaturated air, as determined eadings of the dry and wet bulb thermometers concurrent occurrence of unsaturated air is pendent of the intensity of the fog, even the rity of the very thick fogs being so accompanied **Jameson** Temperature observations on Adam's , Ceylon Observations of temperature made at summit of Adam's Peak, Ceylon, altitude 7360 feet, wenty three days in January and February 1930, discussed and compared with simultaneous ob- ns at Nuwara Eliya, a valley station at 6170 The night temperatures showed the normal e es between a valley and a peak site During la, however, there was a sharp rise of tempera- in the morning, lasting until about 11 A.M, and giving much higher temperatures than might be expected at that altitude This was followed by a steady fall, until the constant night temperature was reached about 6 P M These day temperatures were probably due to mountain winds converging up the Peak in the morning, and forming cloud over it before midday —**S P Wiltshire** The correlation of weather conditions with outbreaks of potato blight The present investigation has been carried out to see if the correlation established by Dutch workers between the weather and blight outbreaks holds good in England, and the results obtained indicate that while the requisite conditions occur more or less regularly before outbreaks, such conditions are not invariably followed by attacks of the disease The fact that outbreaks do not usually occur without the weather requirements being fulfilled, though negative in character, appears to be of value in practice, and in the intensive seed potato growing area of Friesland, where as many as ten sprays may be applied in a year, the service has enabled the grower to wait with some degree of safety for appropriate weather conditions before spraying

Paris

Academy of Sciences, Mar 16 —**L Cayeux** The epigenic origin of the Jurassic dolomites of the Pyrenees The formation of these dolomites is a case of the general problem of the dolomitisation of a limestone —**H Vincent** and **L Velluz** The cryptotoxic properties of the halogen substituted oxybenzoic acids The results of a systematic study of the cryptotoxic properties of the chlorine, bromine, and iodine derivations of salicylic acid Salicylic acid is from two to three times as active as its isomers, and sodium diiodosalicylate possesses 280 times the cryptotoxic activity of sodium salicyl- ate it also possesses antiseptic properties —**C de La Vallée Poussin** Some extensions of the method of *balayage* of Poincaré and on the problem of Dirichlet —**E Mathias** The existence or non existence of lightning *en chapelet* —Thomas Hunt Morgan was elec ... *correspondant* for the Section of Anatomy and Zo ... —**Arnaud Denjoy** Riemann's hypothesis on ... distribution of the zeros of $\xi(s)$, related to the th ... of probabilities —**Paul Lévy** Some theorems ... enumerable probabilities —**G Pfeiffer** The construction of the general operator permuting the intervals of a linear and homogeneous partial differential equation of the first order —**E Kogbetliantz** The summability (C, δ) of developments according to Hermite polynomials —**Henri Mineur** The dynamics of variable masses according to the laws of Newton and of Einstein —**Mme E Chandon** The mean depth of a canal calculated by means of the harmonic constants of two stations —**E Fichot** Remarks on the preceding communication —**L Brillouin** —Elasticity, thermal agitation, and fusion of solids —**Paul Ansiau** The realisation of a mercury vapour pump Description of construction, with a diagram, mode of working, and performance of a mercury vapour pump —**Pierre Auger** and **Mlle Thérèse Meyer** The directions of emission of photoelectrons Experiments have been carried out with the $K\alpha$ radiation of uranium, and the results compared with calculations based on Sommerfeld's theory —**Mlle M Chenot** The phenomena of propagation in ionised gases by discharges of very high frequency —**Constantin Salceanu** The magnetic rotatory polarisation of some higher homologues of the organic fatty acids The acids studied were decanoic, lauric, myristic, palmitic, and stearic Perkin's rule is only true as a first approximation, as systematic differences appear for the higher terms —**Pierre Montagne** The application of a square

diagram to the representation and calculation of the equilibrium in the water gas reaction —**R Wurmser** and **J Geloso** The oxido-reduction potential of solutions of glucose —**L Bull** and **Mlle Suzanne Veil** The kinetic study of Liesegang's rings —**Picon** Pure cerium sulphide Sterba's method, the interaction of cerium oxide and hydrogen sulphide at a high temperature, gives a product free from oxygen provided the temperature is 1500°-1600° C At 1000° C the sulphide still contains 2 per cent of oxygen The pure sulphide melts at 2200° C and is stable at the melting point The reaction with carbon dioxide at 700 C is unusual, $Ce_2S_3 + 4CO_2 = 2CeO_2 + 4CO + 3S$ —**M Bourguel** The formation of an intermediate form in an acetylene transposition The prolonged action of sodium amide at 60°-70° C upon $C_6H_5C \equiv CCH_3$ gives a sodium derivative, from which treatment with dilute acid gives $C_6H_5CH_2C \equiv CH$ and an isomer which does not react with ammoniacal cuprous chloride This isomer absorbs oxygen giving $C_6H_5CO\,CO\,CH_3$, and its composition is undetermined —**Henri Termier** The discordances of the meso and cenozoic series in Central Morocco and the Middle Atlas —**L Eblé** and **J Itié** The values of the magnetic elements at the Val Joyeux station (Seine et Oise) on Jan 1, 1931 The only special point is the clear increase in the vertical component This has now the same value as it had on Jan 1, 1911, after having undergone in the twenty year interval an oscillation characterised by a relative maximum in 1918 and two minima in 1915 and 1926 —**N P Péntcheff** The proportion of krypton and xenon in some Bulgarian natural gases The spectrophotometric method of Moureu and Lepape was used in these determinations The results are in agreement with the astrophysical theory of Moureu and Lepape **Kalé** Contribution to the morphological study of the stem of *Triticum vulgare* —**P Vignon** The teeth of the labrum of certain gasteropods with turbinated shell, and the relations which they may develop with the varices —**Mlle Odette Tuzet** The parabasal apparatus and the dictyosomes in *Reniera simulans* ai *Hymeni acidon sanguinea* —**Maurice Piettre** and is **Celan** The rôle of the different cellular elei its in the mobilisation of the lipoids in the mam uy gland, Donné's corpuscle —**Maurice Lecamp** Experimental duplications of the posterior limbs in the toad *Alytes obstetricans* —**Ch Joyeux** and **J Pieri** The hibernation of the virus of Mediterranean exanthematic fever It is proved that *Rhipicephalus sanguineus* can harbour the virus of this fever during the winter, or for at least the first part of the winter There are indications that the virus is attenuated by this hibernation

GENEVA

Society of Physics and Natural History, Nov 20 —**Arnold Pictet** The existence of two markings in guinea pigs, one dominant, the other recessive In guinea pigs, the marking of the body is dominant in the monohybrid of uniform coloration, whilst the marking of the extremities is simply recessive These two monohybrid systems fit into each other to form a dihybrid system, so that the heredity relations between the uniform fur and the two kinds of markings are governed by a double pair of inheritance factors —**E Bovier** The ammonites of the upper Sinemurian of Champfromier (French Jura) The author gives a list of the ammonites from the Lias which he has collected at Champfromier From these the presence of the three following Oppel zones is inferred *Echioceras raricostatum* zone, *Oxynoticeras oxynotum* zone, and *Asteroceras obtusum* zone He then points out the differences observed between the sections of
British authors and his results, as ‹
value to be attached to the stratigra|
of the late S S Buckman —**Henry**
optical activity of certain anthrace e a‹
By the reduction of benzyloxan hro ie β carb‹
acid ($[\alpha]_D^{20} = -71\ 6°$) an optically inactive γ ben
anthracene β carboxylic acid is obtained Thi
tends to prove the non existence of a medial lin
between the atoms of carbon 9 and 10 of the an‹
cene Its value as a crucial test, however, is dimin
by the fact that the inactivity of the γ-be
anthracene β carboxylic acid thus obtained r
not be due to the constitution of the acid itself,
to a racemisation produced during the reductic
R Wavre The axes connected with a fluid
criteria of stability The author shows at the
that the central axes of inertia and the axes com
to the equivalent solids must be distinguished
then points out a general criterion of stability
relative equilibrium from which he deduces a
ticular cases the criteria of Poincaré and Kelvin
general method will be developed in a work c
whole question —**G Tiercy** The dimensions
terrestrial spheroid The author notes that the
for the terrestrial flattening 1/294 takes acco‹
the second approximation, of all known measure
whether geodetic, precessional or of the mean su|
density of the earth The author adopts thi
although the geodetic institutes admit others,
1/297 Taking all known measurements into a
he derives the following values for the axes
terrestrial spheroid,

Semi-major axis = 6378 250 kilometres
Semi minor axis = 6356 555 kilometres

Dec 4 —**Jean Weiglé** The work of removi
trons The work which must be supplied to tea
electron from a metal is due, at least in part
electrostatic attraction of the metal on this el‹
This problem is treated by the method of image
the force thus calculated is called the force of the i
The author has studied these forces when the
is surrounded (1) by an infinite dielectric, and (
a dielectric layer He has also considered the t
of images in dielectrics from a general point of
These theoretical results may be submitted to va
experimental proofs suggested by the author —
Rossier The index of absolute colour and st
statistics This study comprises the calculatio
the difference, visual magnitude of a star minus
bolometric magnitude properties of the minir
of the difference The application to the eye ap|
to be fairly exact, especially for hot stars The
portion of hot stars is higher than that given by v
observations A difficulty in Russell's evol‹
theory is thus eliminated —**Charles Jung**
albumin and globulin of the blood serum
author's experiments appear to prove that preci
tion by sodium sulphate in solution graduall|
creasing in concentration gives globulins in whicl
nitrogen percentage also increases The fraction
cipitated with the proportion 21 5 per cent d
little from that precipitated by carbon dio
according to the technique employed The ave
nitrogen percentage of the total globulins is 14 ‹
cent, which would lead to the factor 6 75 when d
mining by nitrogen, admitting that the propo‹
of englobulin and the pseudo globulins varies
slightly —**E Galfre** The study of some ele‹
chemical phenomena in metallic osteosynthesis
a result of various researches on osteosynthesis,
author has arrived at the conception that it is ele‹
lytic phenomena which preponderate in oper
failures Working with various pieces of prot

series is comparable to other complexes of inian age, and, therefore, probably belongs to Kainmbla epoch of igneous intrusion — G H ingham The Gasteromycetes of Australasia: The Phallales (1) Following a discussion concing the morphology of the order, an account is of the development of three representatives of genera, *Mutinus*, *Ithyphallus*, and *Dictyophora* ectively A key to the genera is given, and the ies occurring in this biologic region (five in all) discussed in detail Critical notes are appended o the generic limits and to the specific characters he Australian representatives of this family A nplete synonymy of the species and genera under ussion is appended — J R Malloch Notes on stralian Diptera (27) This paper contains a nplete catalogue of the described Australian species the family Chloropidæ, with a generic key to the family Chloropinæ and descriptions of thirteen v species, with notes on several described species, urvey of the characters of the family Milichidæ, a key to the Australian species of the genus *ichiella* and descriptions of two new species, and notes on three recently described species of the *Rutilia* of the family Tachinidæ

WASHINGTON, D C

nal Academy of Sciences (*Proc*, Vol 17, No 2, 15) — **Henry Borsook and Howard M Wineden** On the specific dynamic action of protein urvey of recent experimental work, with reference the literature It is suggested that the specific namic action of protein parallels the course of rogen excretion and results from at least two prosses, the work imposed on the kidney and the tabolism of the nitrogen and the carbon, the latter ing the specific dynamic action proper — **Perry erly** The California earthquakes of Nov 28, 1929, l the surface layers of the earth in California ese two earthquakes were recorded by several ervatories near the epicentre Both the direct and irect *P* waves were identified, and a method allowof the accurate calculation of the depth of focus used The epicentre was at lat 37° 31′ N, long ° 2′ W, the focus was at a depth of 5 km, and granitic layer in the region is 20–25 km — **Clyde E ler** The independence of dominant spotting and essive spotting ('piebald') in the house mouse — **C. Ramsperger and G Waddington** The intertation of the thermal decomposition of nitrous ide Data of all known unimolecular actions are luded — **Wilder D Bancroft and J E Rutzler, jr** versible coagulation in living tissue (1) Intraous injections of sodium thiocyanate solutions ng rabbits out of the unconsciousness due to ether, ytal, or morphine more rapidly than is normal, can event death from strychnine or histamine, and can event anaphylactic shock in rabbits sensitised with g white sol Potassium salts cannot safely be sub tuted for sodium salts, because of their greater toxic tion. It is considered that since sodium thiocyanate ptises proteins, its effect is to counteract disturb ce due to coagulation of nerve proteins, this pports Claude Bernard's view that anæsthesia is e to coagulation of nerve colloids — **Tracy Yerkes omas** On the unified field theory (4) A conleration of the so-called geodesics of zero length iich give the light tracks in the Einstein theory of witation — **Leonard Carlitz** The arithmetic of lynomials in a Galois field — **Hassler Whitney** (1) the colouring of graphs —(2) Non-separable and nar graphs. — **Francis D Murnaghan** The prin le of Maupertuis. — **A. D. Michal** Notes on scalar extions of tensors and properties of local co-ordinates

Official Publications Received.

BRITISH

Ministry of Agriculture and Fisheries Marketing Leaflet No. 30 Litter Testing and Pig Recording, Interim Report by the Pig Industry Council. Pp 8. (London Ministry of Agriculture and Fisheries)

Department of Scientific and Industrial Research. Building Science Abstracts Vol 4 (New Series), No 4, April. Abstracts Nos. 585-747 Pp 107 146 (London H M Stationery Office.) 9*d*. net.

Air Ministry Aeronautical Research Committee. Reports and Memoranda. No 1361 (E 40—1 C.E. 761, 790) Carburettor Fuel Metering Characteristics. By W C. Clothier Pp. 12+15 plates (London H.M Stationery Office) 9*d* net.

Proceedings of the Royal Irish Academy Vol. 40, Section B. No. 2 Contributions to the Fungus Flora of Ulster By Arthur E Muskett, E. Norman Carrothers and Hugh Cairns Pp. 37 55 6*d*. Vol. 40, Section B, No 3 Further Studies in the Pigment of the Berry of the Elder (*Sambucus nigra* Linn). By Thomas J Nolan and Hyacinth M T Casey Pp 56-66 6*d* (Dublin Hodges, Figgis and Co., London Williams and Norgate, Ltd)

Transactions of the Institute of Marine Engineers, Incorporated Session 1931, Vol 43, No. 4, May Pp. 15" 202+xlii. (London)

Journal of the Chemical Society May Pp. iv+1039-1314+x. (London)

Proceedings of the Geologists Association Edited by A. K. Wells. Vol 42, Part 1, May 28th Pp. 85 (London Edward Stanford, Ltd) 5*s*

The International Commission on Illumination The Origin, Organisation and Work (with Appendices). Pp. 24 (London The International Illumination Congress.)

The University of Sheffield Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1929-30 Pp 14. (Sheffield)

City of Birmingham Education Committee. Selection of Skilled Apprentices for the Engineering Trades Report of Research By E Patricia Allen and Percival Smith Pp. iv+35 (Birmingham)

The British South Africa Company Publication No 1 The South African Citrus Thrips in Southern Rhodesia. By Dr W J Hall Pp. 56+8 plates (London and Salisbury The British South Africa Co)

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein Deel 1 Stuk 2 Die Krytfauna van Soeloeland 2 Voorlopige Beskrywing von enige Soeloelandse Ammoniete 1 Lophoceras, Rhytidoceras, Drepanoceras en Deiradoceras. Deur Dr Ir E C N Van Hoepen Pp 39-54 (Bloemfontein)

Mines Department Safety in Mines Research Board Paper No 66 Haulage Accidents in Coal Mines. Report of the Haulage Committee of the Safety in Mines Research Board Pp 20 (London H M Stationery Office) 6*d* net.

Ten Years of Research for the Metal Industries a Brief Record of Progress made by the British Non Ferrous Metals Research Association, 1920-1930 Pp 30 (London)

The League of Science (The Science Party). Report on Preliminary Work and Activities from 11th November 1929 to 1st May 1931 Pp. 8. (London)

Brighter Biochemistry being the Illustrated Journal of the Bio chemical Laboratory, Cambridge No 8, May Pp 38 (Cambridge) 2*s*.

National Health Insurance Memorandum on Certification of Incapacity for Work, giving the Results of Recent Investigations as to the Causes of Increase of Claims to Sickness and Disablement Benefit. (Memo. 329/I C) Pp. 31 (London Ministry of Health)

Navy Hydrographer's Report. Report on Admiralty Surveys for the Year 1930 by the Hydrographer of the Navy Pp. v x (London Admiralty)

The Quarterly Journal of the Geological Society of London No. 346, Vol 87, Part 2, May 29th Pp. 179 375+lxiv (London Longmans, Green and Co., Ltd) 7*s*. 6*d*.

Empire Cotton Growing Corporation Report of the Tenth Annual General Meeting. Pp. 16 (London)

Proceedings of the Royal Society Series A, Vol 131, No A818, June 2 Pp. 517 703+xxx (London Harrison and Sons, Ltd) 10*s*

Apia Observatory, Apia, Western Samoa. Report for 1927 Pp 86. (Wellington, N Z W A G Skinner)

Records of the Botanical Survey of India. Vol 13, No. 2 A Census of Indian Mosses, with Analytical Keys to the Genera referred to in the Census as well as all the Genera dealt with in the second edition of Prof Brotherus account of the Musci Veri in Engler and Prantl's "Pflanzenfamilien" By P Bruhl Pp v+152. (Calcutta Government of India Central Publication Branch.) 2 12 rupees 5*s*

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1931 June 6 Pp. 17 (Greenwich)

Imperial Bureau of Plant Genetics (for Crops other than Herbage). Papers on Plant Genetics received from January to June 1930 Pp 23 Papers on Plant Genetics, Vol 1, No. 2. Pp 36 Plant Breeding Abstracts, Vol 1, No 3 Pp 52. (Cambridge School of Agriculture)

Canada Department of Mines Mines Branch The Mining Laws of Canada a Digest of Dominion and Provincial Laws affecting Mining (No 718.) Revised edition. Pp. v+98. 25 cents. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1929 (No 720) Pp ii+208. (Ottawa F A Acland)

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1930 Pp. 9 (Cape of Good Hope.)

County Borough of Halifax Bankfield Museum Notes, Second Series No. 12 Methods of Hand Spinning in Egypt and the Sudan. By Grace M Crowfoot. Pp. 51+44 plates. (Halifax) 5*s*.

Ministry of Agriculture and Fisheries Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1929-1930. Pp. 280. (London Ministry of Agriculture and Fisheries.) 1*s*. net.

Tanganyika to the Cape, especially the country south of the Zambezi—in the ravines running down the sides of the mountains The finest paintings and the surfaces on which a number of pictures are closely grouped one upon another are usually found in narrow gorges through which flow the more important streams The sites in the secondary gorges and on higher ground are less numerous and generally not so rich

Stow's work does not include copies from all the areas in which paintings have been found, nor, as we have said, did he copy all the drawings in each shelter Nevertheless, his selection gives a richly documented view of the rupestral pictorial art of the country in which he worked The fauna figured is abundant and varied All kinds of antelope are there—above all, the eland, which is figured so often as in the end to become stereotyped Elephants are numerous, rhinoceros and hippopotamus rather rare, quaggas, zebra, and giraffe are not lacking, of the smaller animals, baboons, jackals, hares, and boars appear occasionally only, among the carnivores, the lion and the leopard are most frequent In the most recent paintings, oxen, sheep, and dogs, with Bantu herdsmen, take a prominent place and are well rendered The horse, which was introduced in the last century only, is less successful It is occasionally shown ridden by Europeans With the exception of the ostrich and the crane, birds are rare, but there is a number of serpents, principally the python As for fish, tortoises, and frogs, these appear only in the mythological scenes Insects, as well as vegetation, are seen only exceptionally However, it is to be noted, Rhodesia affords a number of examples of trees

Man, both sexes, and alone or in groups, appears in abundance, and engaged in all sorts of activities, hunting, dancing, fighting, running, and the like As a rule, the figures are nude, but some are clothed in skins, generally in recent paintings in which Bantus also appear, as well as domestic animals—some of which are European domestic animals Some of the figures have the head of a bird or a mammal, this occasionally in connexion with the chase, sometimes in connexion with the metamorphoses in which the Bushmen believed No inanimate objects are represented, if those which are being used by the human figures are excepted Nor is there any attempt to represent the landscape, unless this interpretation is to be placed on a number of dots which may be a fold or enclosure Once only a marsh is indicated Here also we must note that, in Rhodesia, marshes, rocks, and rain are represented frequently Some sym are compared by Miss Bleek with those w occur with such frequency in the rock-engra of the Vaal and the Orange River

There can be no doubt, according to Miss I that all these paintings are the work of the B men Fifty years ago the surviving Bushmen claimed them as the work of their race Furth they are not all contemporary While the old pictures of animals are the best, those of m attained greater accuracy as it became necessa to distinguish different races by a more exact sentation of their characteristics

The colours employed by the artists are re all shades, yellow, brown, chocolate (ochre clay), black (charcoal), white (oxide of zinc), r blue or blue-grey (phosphatic nodules from schist), and violet The pigments were ground

Miss Lloyd remarks that in case of superpositi the older drawings are often dark red or yello a fact which she attributes to the more lasti qualities of these colours She has noted t the white of the polychromes tends to dis and that white is not used in the oldest p I cannot mention these observations making considerable reservations, as they part, contrary to facts I have observed my No doubt they are drawn from localities c than those I have visited The subject is c which requires for its complete elucidation a pr longed study, which it has not yet received any case, according to Miss Bleek, blue, rose, a violet are found only in the later paintin Further, Miss Bleek has observed, and herein s is in agreement with me, that red figures are sup posed on black and vice versa The distribution colours in a figure is, as a rule, conventional, l occasionally naturalistic

The sandstone of the shelters, which are not any great depth, is, according to Miss Bleek, m often than not fairly friable and scales readily would add that elsewhere it is far more resista The figures often blend into the background T does not come out in Stow's reproductions, whe the background is conventional There are al paintings in niches apart and on isolated bloc The greater number of the paintings are at medium height The best preserved are fou towards the top, where they are out of the re of the rubbing of cattle Trees and vegeta where there are any, have exercised a pr influence

How old are the most recent of these pai The extinction of the Bushmen may be pl

nety years ago in the region of Queenstown, at ghty near Barkly, and at sixty in the Orange Free te and Basutoland That they knew and under- ood that the subjects painted were scenes in history of their own race is established by the lowing facts Stow showed some of his copies the aged members of a Bushman family They eclared, not without emotion, that one was a epresentation of a dance of their tribe, and they eproduced it with appropriate song accompani- nent In 1870-75, Dr W H I Bleek and Miss C Lloyd, after learning the language of the shmen of whom they were in charge, showed m Stow's drawings, and obtained from them an planation of them and an assurance that they re the work of their race Many of the mythical l mythological explanations which appear here ith the plates are derived from this source and hrow a curious light on Bushman beliefs It was t about this time that Orpen obtained his in- ormation, and it was about 1886 that Maluti, the st artist of the Bushman tribe, was killed at tte Bergen Colonial Native Reserve, when he carrying in his belt little horn pots each con- ning a different coloured paint Naturally, the ushmen of the Kalahari, where there are no ocks, are ignorant of the art, as are also those who ave been able to survive in captivity or in de ising conditions In any case, between 1878-80 id 1910 the folk lore of the race has become quite tinct among the survivors around Prieska

That some of the paintings are not older than le last century is certain There are some which ow Bantus, the date of whose arrival in certain eas can be fixed with certainty There are hers which represent Europeans dressed in the stume of the time of Queen Victoria But it is ident that there are some—and those a consider- le number—which are much older At Invani, ar Queenstown, Stow noted five layers of paint- s superimposed, and as he had learned that the shmen did not cover the work of an artist as ng as his memory persisted, he concluded that is would give an age of about 500 years for the dest of the paintings There are some which e certainly earlier, but Miss Bleek is unable to d any criterion which will establish this as oved fact She is of the opinion that the dis- egration of the rock would not admit of the rvatio of paintings of any very great age es she think it would be po le to rely on lence of degeneration in t art towards , for there are excellent ex iples among st recent paintings, and poor among the most ancient Large polychrome figures of animals are obliterated by monochromes, or the reverse, there are horses among the polychromes, and mono- chromes occur at all stages, although the red and orange, offering greater resistance as they possess more lasting qualities, are among the most ancient

I should like to add a few words on the points raised in the preceding paragraph While it is true that there are certain rocks which disintegrate rapidly, there are others which show as much power of resistance as those of the rock shelters of eastern Spain, which are of palæolithic date, and of which the paintings show much the same ap- pearance of fossilisation as they do in this region There are many among these ancient paintings which can be seen only when they are wet I am, therefore, of the opinion that many are much older than Miss Bleek thinks Even if the white loses its brilliance, it is still there On some of the oldest of the pictorial sites in Rhodesia there are whites, and I have seen them in the Orange Free State and at Queenstown I think that, after long, patient, and widely extended study, it may be possible to arrive at some definite conclusion as to the relative age and chronology of the South African art of rock painting Relying on my ex perience in Europe, I have attempted certain pro visional suggestions based upon what I was a to see during my stay in South Africa I am n the less convinced that the work has still done, and that it will be a long business F I am sure that Stow's reproductions for t part belong to a relatively late stage—perha indeed, very late The investigation would have to proceed by the study of large natural regions, rather as Mr Burkitt and, more recently, Dr L Frobenius have done

Miss Bleek has devoted considerable space to the Bushmen race, the only race she considers to have a gift for pictorial art Before the arrival of the European, they were bounded on the west by the Hottentot and on the north and east by the Bantu races, with whom they were engaged in warfare Although they belonged to one race, they were differentiated in their languages, their beliefs, and their customs I would add that, so far as is indicated by the fine models from life in the Cape Town Museum, they showed appreciable differences in physical character For example, steatopygia does not appear in the southern group Miss Bleek affirms positively that there were not only several languages, but also several groups of languages, which does not seem to fit in with a strict unity

The Bushmen lived near water-holes, in groups

sets out to give a clear explanation of the implications underlying the new theory This he does, not merely by the routine of mathematics developed for the solution of problems, but by a detailed discussion of important *Gedankenexperimente* which provide good illustrations of the operation and range of the 'uncertainty principle' and bring out very clearly one of the main points of philosophical interest associated with the new ideas This is that it is necessary either to abandon the classical conception of causality in space time descriptions of microscopic phenomena, or to retain the principle of causality at the expense of the space time description, substituting for it a mathematical description not in space and time

This book should be read by all interested in modern physics, especially as it is written by one of the pioneers of the new theory

(3) These two volumes by Prof Léon Brillouin on the quantum theory are written with a lucidity of expression which is characteristic of the author, and they contain a mass of detail on statistical theories about which there has recently been nothing less than a revolution in thought

The earlier chapters of the first volume are devoted to a consideration of the classical theory of radiation and to the old form of the quantum theory Apart from the intrinsic value of the subject matter, it is an excellent introduction to the newer work, and is written in the light of the recent advances From these earlier chapters we pass to the recent developments due to Bose, Einstein, Fermi, and Dirac with applications to radiation and to the theory of gases

In the second volume the first chapter deals with the interesting examples afforded by the study of electrons in metals to the new theory The modern theory of electrical and thermal conductivity, of the Peltier and Richardson effects, and of contact potential are among the fascinating problems treated One chapter is devoted to the evaluation of electronic mean free path, and in another the treatment of the degenerate electron gas is given

A glance at the table of contents will show that these are merely a few examples of the subject matter The present position of the modern electron theory of metals is such as to awake optimism concerning its future The treatment of these problems by the new methods should arouse the interest of the teacher, who can confidently introduce them to his students, and as advance along these lines is rapid, the research worker must keep abreast of these developments For both purposes these volumes are to be recommended

Our Bookshelf.

Ethnologischer Anzeiger Jahresbibliographie und Bericht über die völkerkundliche Literatur Herausgegeben von M Heydrich Band 2, Heft 4 Pp 129 200 (Stuttgart E Schweizerbart'sche Verlagsbuchhandlung (Erwin Nagele) G m b H, 1930) 9 40 gold marks

IN the bibliography of which this is a part, it is proposed to cover the literature of ethnography, including folk lore and religion, from 1924 to 1930, in three volumes Bibliographical work in anthropology, now more than ever, is a serious undertaking Here, for example, in dealing with one section of the science only, though certainly the largest, there are more than a thousand entries to cover part only of Africa—from "Lequeux" to the end—and a part of Europe—down to "Pallin" under "Finno Ugrian Peoples", near, though not quite at, the end of the main heading Even within these limits, the entries are not complete—English literature is not too well represented, especially under Africa, and the years 1926 and 1927 only are covered A few entries are archæological rather than ethnographical A very useful feature of the publication is that some less accessible contributions to anthropological literature, especially those appearing in the eastern European languages, are abstracted

Each main heading of the bibliography has been entrusted to one or more experts for purposes of compilation Bibliographical work, however, in anthropology more than in any other science (except perhaps zoology), demands international co operation if it is to be anything like complete There are at present in existence a number of bibliographies For the most part, each one deals with some single aspect of the science But even so, these specialist bibliographies overlap at times, and none of them is complete Since the International Catalogue of Scientific Literature ceased publication in 1914, no attempt has been possible in the direction of a full and adequately complete bibliography of anthropology as a whole It is a matter which might well engage the attention of the Committee for Intellectual Co-operation under the League of Nations

Biology for Schools a Textbook suitable for School Certificate and similar Examinations By Dr E R Spratt and A V Spratt (School Examination Series) Pp viii + 403 (London University Tutorial Press, Ltd, 1931) 4*s* 6*d*

THE demand for school text books of biology is still small when compared with that for text-books in almost any of the generally recognised subjects of the curriculum It is then a matter for compliment to the publisher who can produce a book of more than four hundred pages, well bound, well printed, and containing an average of more than one illustration per page, for the modest price of 4*s* 6*d* The authors have compiled a very considerable amount of useful information, and many of the original drawings (especially those of floral structure) are admirably executed

At the same time, there appears to have been

little time or opportunity for revision of the text, so that a number of corrections will be required in a subsequent edition There is no acknowledgment, in the preface, of borrowed illustrations, and though a certain number of these are acknowledged in the text, there remain a few which are not For example, Fig 19 is scarcely distinguishable from that of the same subject (mustard seedlings) by Sachs Fig 196 bears an equally close resemblance to that of the lungs in Thornton's "Physiology", while in Fig 215 one recognises the old familiar spotty frog from Sir Arthur Thomson's "Outlines of Zoology" Among the original drawings which will require correction are Figs 168, 221, 232, 245, and 301 A number of errors also creep into the text For example, the experiment on p 36 concludes with the word "absorbed" where "transpired" is presumably intended, the description (as well as the illustration) of the trout on p 232 will give pain to any honest angler—"scales of calcium carbonate, commonly called chalk", is only part of the heresy These lapses will, however, be easier to rectify than a tendency which runs throughout the book to hurry from description to description, without a pause to consider or to summarise the broad principles involved

The Practical Dog Book with Chapters on the Authentic History of all Varieties hitherto unpublished, and a Veterinary Guide and Dosage Section, and Information on Advertising and on Exporting to all parts of the World, a Comprehensive Work dealing with the Buying, Selling, Breeding, Showing, Care and Feeding of the Dog By Edward C Ash Pp xxxii + 343 + 44 plates (London Simpkin Marshall, Ltd, 1930) 21*s* net

IT is four years since we had the pleasure of reviewing Mr Edward Ash's magnificent and encyclopædic work, "Dogs their History and Development", and it is a pleasure to receive another work on the same subject from his able pen

The present book covers, to a great extent, the same ground as his former one, but in a very much shorter and more concise manner In addition to a series of excellent descriptions of the various breeds of to-day, with their histories, there are sections which deal with the care and management of kennels in general and their inmates, both in sickness and in health For those taking up dog-breeding as a hobby or a career, there are invaluable chapters dealing with the transport and export of dogs to foreign countries, with quarantine regulations at home and abroad, and the latest possible information regarding the showing of dogs in every country in the world

The book is profusely illustrated with a series of beautiful plates These fall into two groups which form an interesting and instructive contrast One group consists of the dogs of yesterday, which include not only the dogs of the past century but also dogs from the very beginning of things The second group is composed entirely of the best specimens of the dogs of to-day

Mr Ash has collected together in this work a thousand and one items of information about dogs in general, which should be of the utmost value to anyone concerned in the breeding and exhibition of these animals To the dog lover and student of history, also, the book should be of the greatest value and interest

The Origin and Growth of Religion Facts and Theories By Prof W Schmidt Translated from the original German by Prof H [illegible] Rose Pp xvi + 302 (London Methue[illegible] Co, Ltd, 1931) 15*s* net

IT was a happy idea that urged Pater [illegible] write this manual for the comparative [illegible] religions, and a still happier one that pr[illegible] Prof Rose to translate it into English [illegible] based on notes for a year's course of the auth[illegible] lectures and covers the history of the subje[illegible] sketches the various theories, movements, an[illegible] schools, and gives a brief account of the religions in the order of their appearance A book of this kind was badly needed, especially for students in England, where ideas about method are apt to be a little nebulous, and where, perhaps, too little attention has been paid to development in theory on the Continent

Pater Schmidt has based his exposition on his great work "Ursprung der Gottesidee", still in course of publication, and his criticism, especially of Tylor and the English animists and pre animists, is orientated in accordance with his views on the priority of the belief in 'high gods' He is less than respectful to the English 'diffusionist' school It is evident that the author is not fully acquainted with the movement of anthropological thought in England and does not understand the various ways in which it develops The tone of his criticism of Tylor's alleged silence on the subject of 'high gods' is unworthy While his health lasted, Tylor neither ignored nor attempted to burke criticism of his views, but he did not rush into print Unfortunately, the same tone appears, if not so pronounced, in Father Schmidt's criticism of 'Protestant' anthropologists The only appropriate reply is a *tu quoque* In neither case is the cause of science advanced Some of the excellent notes added by Prof Rose here serve to palliate the defects

Intermediate Mechanics Dynamics By D Humphrey (Longmans' Modern Mathematical Series) Pp x + 382 (London, New York and Toronto Longmans, Green and Co, Ltd, 1930) 10*s* 6*d*

THE author of this book has set out to fill, in the case of dynamics, the gap that often exists between the normal senior school course and scholarship work in a subject, and he has succeeded admirably, though, in view of the fact that he does not hesitate to use the methods of the calculus whenever they are helpful, the detailed proof that 60 m/hr = 88 ft/sec seems somewhat outside the scope of the book The arrangement is generally good, and the argument clear, the examples are plentiful and well graded, in many cases being accompanied by excellent notes as to appropriate methods or special difficulties

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

C[illegible] Nature of Certain Potato Viruses of the Mosaic Group

[illegible] some experiments on the transmission of a [illegible]osaic virus to tobacco revealed the curious [illegible]t needle and aphis (*Myzus persicæ*) inoculation [illegible]tively, from the same mosaic affected potato [illegible]t, produced in tobacco symptoms characteristic [illegible]he method of infection[1] The disease produced by [illegible]e needle has since been shown to be a complex, the [illegible]onstituent viruses of which for the sake of clarity will be referred to as x and y, where x represents the virus which forms in tobacco double concentric rings with a central spot hereinafter referred to as 'ring spot', and y represents the aphis borne virus the symptoms of which take the form of a darkening of the green colour of the tissues along the veins

This phenomenon has formed the basis of further studies carried on since that time, and the following facts which have been elucidated seem worthy of record By the development of a technique of virus isolation from a complex within the living plant much evidence has been accumulated that certain potato viruses of the mosaic group are not single entities but are composite in character This is true of the following, among others—a mosaic from Arran Victory potato a crinkle from Myatt's Ashleaf, a streak carried without symptoms by Up to date, and a streak also carried by Dr Vernon All these diseases have been separated into their constituent viruses by means of the technique which will now be briefly outlined

The methods of virus isolation used in these studies fall into three groups, and separation was effected in the following ways

(1) By utilising a selective relationship which exists between the aphis vector *Myzus persicæ* and the tobacco plant

(2) By the use of what may be called 'filter' plants A comparative study of the host range of the single virus (y), isolated by means of the insect and of the virus complex ($x+y$), revealed the fact that there were several plants which were susceptible to the ringspot virus (x) but were resistant to the aphis transmitted virus (y) This fact suggested the possibility of using certain of these plants as filters, and experiment has shown that passage of the whole complex ($x+y$) through such plants removes the aphis carried virus (y) That the virus y is actually removed by this process is shown by the analysis and synthesis of the complex frequently carried out, and by the fact that the aphis cannot pick up the virus y from a ringspot resulting from passage of the complex through one of these filter plants

It should perhaps be pointed out that successful filtration by means of these plants is dependent upon the needle scratch method of infection, grafting transmits the whole complex Examples of plants susceptible to the virus y isolated by means of the aphis are *Hyoscyamus* sp , tomato, and *Solanum nigrum*, and of the 'filter' plants resistant to this virus, *Datura stramonium* and *Solanum dulcamara* among others All are susceptible to the ringspot virus x

(3) By taking advantage of the unequal rates of movement of the constituent viruses within the plant host (*a*) At the moment of development of primary symptoms in the young plant inoculated with the virus complex (*b*) In the ageing plant

By means of this technique it has been possible to analyse in the tobacco plant the virus complexes into their constituent viruses and then to synthesise them Thus, needle inoculation to tobacco from a streak carrying Up to date potato produced a virulent disease characterised by gross lesions and severe necrosis of the veins with no sign of rings, while aphis transmission from the same plant produced in tobacco the disease y, with the characteristic darkening of the green colour of the tissues along the veins On passage of the necrotic complex through one of the filter plants referred to back to tobacco again, the disease took on a ringspot form with numbers of clearly defined double concentric rings, each with a central spot, there was no general necrosis The primary symptoms of this disease take the form of double rings upon the inoculated leaf Now, to a number of tobacco plants showing this ringspot was added the virus y, which had been isolated from the complex by means of the aphis After the usual incubation period the primary symptoms peculiar to the aphis transmitted virus (y) appeared, following rapidly upon this, the rings lost their regular outline, became filled up and degenerated into irregular necrotic lesions, while a severe necrosis of the veins developed In a short time the symptom picture was identical in every respect with that of the necrotic disease before the separation had been effected Further passage through the filter plants again produced the ringspot disease, while the addition to this of the aphis carried virus (y) once more restored the virulent necrotic picture

While the majority of the diseases studied are shown by these methods to contain two constituent viruses, there is evidence of a third constituent occurring notably in a streak and a crinkle There are also certain cases where only one virus can be isolated, at all events by the present technique, and here it is reasonable to suppose that the disease is a single entity

As regards the question of the non transmission by the aphis, of the ringspot disease produced in tobacco by needle inoculation with these potato viruses, the obvious explanation is that the aphis is the selective agent and picks up one constituent only of the complex There is however, some evidence which suggests that this is not the correct explanation, but that the tobacco plant itself plays a part as the selective factor It is hoped to settle this question during the coming season

Finally to avoid confusion, it is necessary to state that the ringspot diseases referred to here are quite distinct from one or more ringspot diseases which affect the tobacco plant in Nature[2] There appears to be no record of the experimental ringspots and necrotic diseases, here dealt with, affecting tobacco in Nature, a fact probably connected with the selective relationship existing between aphis vector and tobacco plant

It is of interest to record that Valleau and Johnson, in a paper recently received,[3] have also suggested the possibility that *Datura stramonium*, one of the 'filter' plants used in these studies, is resistant to a disease in tobacco called 'veinbanding' by Valleau This veinbanding occurs naturally in the tobacco fields of Kentucky and is presumably identical with the aphis-borne virus (y) originating in potatoes

It is evident that future work upon these potato virus diseases must take cognisance of their composite nature

KENNETH M SMITH
Potato Virus Research Station,
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University of Cambridge, April 7

[1] *Ann Appl Biol*, **16**, Nos 1, 3
[2] Smith *Ann Appl Biol*, **18** No 1 Wingard, *Jour Agric Res*, **37**, No 3
[3] *Kentucky Agric Exp Stat Bull*, 309

Anomalous X-Ray Diffraction Intensities

THE accompanying photographs (Fig. 1) show an interesting example of a case where the relative intensities of the lines in any X-ray spectrum may vary without a corresponding change in atomic arrangement. They are Debye photographs of chromium plated wires obtained under different conditions of electrodeposition. It is seen at once that the intensity of the middle line, the (200) reflection, in comparison with that of the other two lines, the (110) and (211), is as strong as normally it should be in the top photograph. In the second photograph it has become relatively weak. In the bottom photograph it has disappeared entirely.

These intensity changes could be explained in various ways if foreign atoms capable of scattering

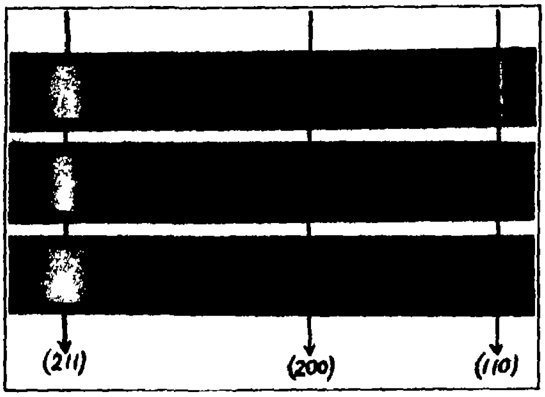

FIG. 1.

X-rays were present to any extent in the deposits. The point of this case, however, is that the metal is apparently free from such impurities. Photographs taken on larger films failed to reveal any appreciable orientation of the grains. The presence of lattice distortion which also might cause the effect, was considered unlikely because the values of the spacings were found to be constant and equal to those usually accepted for chromium.

The probable explanation follows from the work of Laue on X-ray reflection from crystals of a sub-microscopic order of magnitude. The excessive breadth of the lines in the photographs shows that the deposits are composed of such very small crystallites. If those crystals are shaped haphazardly and do not exhibit a preferential habit, all the lines should be broadened in the regular way required by Laue's equations, the broadening being normally larger as the glancing angles increase. But if a majority of the crystals develop a particular form, a flat plate-like shape, for example, or a needle-like shape, then certain sets of planes contain fewer reflecting components, and the resolving power of those planes, in comparison with the others, will decrease until in time they will not produce a spectral line of any degree of visibility. This apparently is what has happened in the case of the (200) line in the photographs. The relative intensities are influenced by the shape of the crystallites.

It is interesting also to note that the type of chromium plating which showed the above effect appeared to be the one characterised by a brilliant lustre. The grey matt type of deposit gave a normal intensity distribution. The full results of the X-ray study of chromium deposits it is hoped to publish elsewhere.

Finally, in view of the fact that the effect occurs with a pure substance, it would seem that the deduction of atomic structure from the relative intensities of the lines on a powder photograph, when the material is in a fine state of subdivision, must be attended with one more complication.

W. A. WOOD.

Physics Department,
National Physical Laboratory,
Teddington, Middlesex,
Mar. 19.

Properties of Dielectrics in Electric Fields

THE issue of NATURE of Jan. 3 contained a letter from Mr. A. Morris Thomas, of the British Electrical and Allied Industries Research Association, in which, while agreeing generally with the principles in my letter in NATURE of Nov. 22 last, he pointed out that the term 'permittivity' is frequently used now instead of 'dielectric constant'.

I was not unaware of this when writing originally, but the term 'permittivity' was proposed by Heaviside before the electrical nature of matter was discovered, and while answering his immediate purpose, it suggests that the action of the field is through the dielectric, while modern knowledge shows that it is directly on the opposite charges constituting the molecules of the dielectric.

Again, modern work shows also that what is called 'capacity' may arise from at least three different causes, which cannot properly be all comprehended under one term, except for special purposes. In two communications to the *Phil. Mag.* (May 1924 and Jan. 1926) I showed that Maxwell's law was true in the case of 11 out of the 19 non-metallic elements of which the value of ϵ was known, including those most important, and that the same almost certainly would apply to, at any rate, 6 of the remainder. The greatest deviation from equality was about 10 per cent.

On the other hand, for many substances, compounds formed of the above elements, the relative values of ϵ and N^2 widely differ.

As to this, it is now generally accepted that atoms and molecules can be divided into two classes.

(1) *Non-Polar.*—In this class, in an outside field there is repulsion of the nucleus and attraction of the electrons but no tendency to orientation. Debye calls this the 'distortion', it is small and any dissipation of energy accompanying it is small also. It agrees approximately with the square of the refractive index.

(2) *Polar.*—In numerous cases the positive and negative charges of the molecules are not symmetrically situated in an outside field: thus, in addition to distortion, they have a moment and tend to be rotated and oriented in line with the field. The capacity of the system is thus increased. This type of capacity, unlike the distortional form, is affected by change of temperature, falling as the temperature is raised and also by increase of frequency.

Both these forms of capacity are due to direct action between the field and the mass of the molecules of the substance acted on. There is, however, a third form of capacity. Ions usually exist in small quantities in dielectrics and constitute polar molecules of the strongest type, with the addition that one pole is stronger than the other; thus, besides orientation, there is a direct pull on the stronger pole of the ion in the direction of the opposite electrode of the field. Thus the capacity of the system is again increased, and at low frequencies this increase may be very large.

In this latter form of capacity the action of the field is on inclusions of electrolytic type, the molecules of which are scattered through the dielectric, and not on the mass of the molecules of the dielectric itself,

as in the two former cases Thus measurement of capacity at a given frequency may contain all the above components In any case, by drying or purification, it is necessary to get rid of, or reduce to a small percentage, the third form of capacity before the other two can be confidently isolated

For technical purposes it is often immaterial to distinguish between the first two forms of capacity, provided the third form can be reduced sufficiently far But measurement and separation of the first two forms is opening up a new chapter in the study of the attributes of non metallic matter itself

The connexion between the properties of matter in an outside field and its other physical properties, however, is not directly through the specific capacity or permittivity, but through the attraction set up between the field and the dielectric, as the result of which the energy is stored, the relative value of which was shown by Boltzmann to be equal to $\frac{\epsilon - 1}{\epsilon + 2}$

This value must again be corrected for the molecular attraction, which should then be a fairly direct measure of the interatomic attraction after allowance is made for polarity

At present there is no suitable name for this important quantity, which is closely connected with cohesion and other physical properties of matter (see the above *Phil Mag* communication, etc), nor for the other forms of capacity mentioned above The time is arriving when it is very desirable that the whole subject of dielectric nomenclature should receive consideration

This letter is rather belated , but I have been unwell and unable to take up the correspondence sooner

G L ADDENBROOKE

35 Holland Villas Road,
Kensington, W 14,
April 7

The Electrical Layers of the Atmosphere

PROF MILLIKAN has recently directed attention to a remarkable property of cosmic rays, in his presidential address to the American Association for the Advancement of Science, at Cleveland [1] He observed that "somewhere in the atmosphere below a height of 15 5 km the intensity of the ionisation within a closed vessel exposed to the rays goes through a maximum, and then decreases "

Unfortunately, Prof Millikan did not connect this behaviour with other data which appear to be closely associated with it In 1925 I directed attention to the fact that three different phenomena pointed to the conclusion that the atmosphere consists of two layers [3] These zones can be distinguished

(1) *Electrostatically*—the negative zone lying above the positive one

(2) *Optically*—at sunrise and sunset when the air is very clear and the observer is situated at least 2½ kilometres above sea level

(3) *Thermally*—the stratosphere or zone of uniform vertical temperature lying above the troposphere or zone in which the temperature falls with increasing height

It appears from Prof Millikan's data that there is still another phenomenon, (4) *the absorption of cosmic rays*, that points to the same conclusion

It is surely time that geophysicists and meteorologists seriously considered these phenomena In central Europe the dividing layer is situated at from 7 km to 12 km above sea-level, judging from thermal measurements in winter and summer respectively The most probable explanation appears to me to be that

(1) Cosmic rays cause ionisation of the air most readily where it has attained a certain pressure

(2) The movements of the gaseous ions result in gaseous diffusion potential layers, analogous to the liquid potential layers in electrolytes studied by Nernst, the light negative ions rising above the slower and heavier positive ions

(3) A state of electrostatic strain is set up between the layers, and where sufficiently violent local vertical movements lead to engulfment of portions of the upper zone by the lower, negative thunder clouds surrounded by a concentrated positive sheath may be observed [3]

The ozone in the air may very possibly be formed in the region of maximum absorption of cosmic rays, since its concentration in the neighbourhood of mountain peaks exceeds that at sea-level [4] The Heaviside layer of the wireless expert has been placed so much higher than the junction of the two zones (85 95 km) that it seems possible that it corresponds to the position of maximum conductivity in the negative zone

WILLIAM C REYNOLDS

16 Southern Drive,
Anlaby Park, Hull,
Mar 31

[1] NATURE, Jan 31, 1931, p 167
[2] NATURE, Sept 12, p 394 and Sept 26 p 480
[3] Reynolds, NATURE, May 30, 1925, p 836
[4] Reynolds *Jour Soc Chem Ind*, Mar 28, 1930, p 168

Disease in Nature

IN the discussion in NATURE of April 25 between Mr Ramsbottom and a reviewer, on the occurrence of disease among animals and plants in Nature, one factor appears to have been ignored, and that is the drastic operation of natural selection in weeding out not merely diseased individuals but also any that carry a weakness reducing their fitness to their environment When the reviewer argues that parasitism may not be a disease but only an "innocuous *modus vivendi* ", is he not begging the question ? Relatively innocuous parasitisms persist just in the proportion that the parasite does not enfeeble the host, but no distinction of kind can be made between them and definitely lethal diseases Animals or plants carrying a 'disease', that is, some lowering of the normal vitality, whether genetic, parasitic, or environmentally caused, are so promptly and thoroughly eliminated that examples will be observed very rarely, because such a very small proportion of individuals of any species are closely examined We hear, for example, of grouse disease because so many thousands of grouse are shot each year What about rinderpest and East Coast fever ? They have taken heavy toll of African game without any intervention of man

Man interferes with Nature by taking off the pressure of selection Our civilisation prides itself on rearing as many as possible of the children born, and from this alone follows the prominence of disease and the relative low ratio of human beings possessed of "exuberant positive health " A native tribe in Central Africa would strike the ordinary observer as exuberantly healthy , the medical officer in close touch with them would tell a different story

So far as my own observation goes, of plants perhaps more than animals, disease certainly exists in Nature if you look closely for it, but the individuals affected are so immediately suppressed that cases rarely fall under observation Let me give a parallel which avoids the question begging term 'disease ' A given species of plant in a certain district may seem to be true to type and free from variation , but bring it into cultivation and grow on all the individuals, then variations immediately disclose themselves Baur has shown

with *Antirrhinum* that the type from a given locality which, to judge from herbarium specimens, has remained constant for half a century, is yet heterozygous and begins to segregate so soon as seedlings are grown on without natural selection In Nature, the homozygotes which are produced every generation would seem to fall below the heterozygotes by just that little which ensures their elimination under competition

A D HALL
John Innes Horticultural Institution,
Merton Park, S W 19,
April 28

DISEASE is a point of view When one organism is living in association with another, the former at the expense of the latter, the balance of metabolism in the latter is always disturbed The latter may be called diseased while the former is happy in having a plentiful supply of food without much exertion In Nature such association is constantly going on A certain system ceases to exist while another comes into being as a consequence In calling Nature 'healthy' or 'diseased' we are projecting the human point of view into its operations It seems to me more profitable to try to consider Nature without being influenced by human prejudices

S MAULIK
London, April 29

Evolution of the Occipital Condyle in the Vertebrata

THE origin of the occipital condyles of the skulls of vertebrata has not so far been elucidated They are separate elements from the occipital arch and are ultimately superimposed on the latter, except in fish The occipital arch is the hinder limit of the skull, and the arch which is the beginning of the vertebral column may be termed the atlas, though it is not homologous in Amphibia and Amniota Between the occipital region and the atlas there is an intervertebral body which acts as a buffer An intercalated arch is present on the dorso lateral sides of this intervertebral body, the existence of which was not previously known, this arch is not complete dorsally and does not enclose the spinal cord, the nerve, spinalis I, passes through or over this intercalated arch

In fish, the limbs of this intercalated arch lie on the sides, a little above the level of the intervertebral body, so that when a strand of migratory connective tissue cells divides each of the limbs into two parts, those look like zygapophyses between the occipital arch proper and the atlas arch proper The anterior portion of the intervertebral body, after the division, fuses with the occipital arch to form the occipital condyle It is concave, as the vertebræ of the fish are amphicœlous

In Urodela, the intercalated arch lies almost at the same level as the intervertebral body, and when the division of the two limbs of the intercalated arch gives rise to the two condyles, the intervertebral body, instead of being divided, fuses with the anterior end of the atlas, thus forming the so-called odontoid process of the Urodela In Anura, the intervertebral body, unlike that of Urodela, becomes divided and one part fuses with the atlas and the other part fuses with the occipital region, in consequence of which there is no formation of an odontoid process

In all Amniota, the limbs of the intercalated arch lie at the sides, a little below the level of the intervertebral body In reptiles, the anterior part of the intercalated arch, which becomes divided from the posterior part, gives rise to the lateral portion of the occipital condyle, while the intervertebral body fuses entirely with the skull to form the median portion of the occipital condyle Thus arises the single elliptical occipital condyle The formation of the occipital condyle of birds is almost like that of the reptiles In mammals it is almost like that of Anura In all Amniota, the atlas vertebra has undoubtedly no centrum, but the ventral (anterior) arch completing the floor of the atlas ring is derived from the posterior portion of the intercalated arch, and not from the basiventralia as has been maintained by previous authors

In reptiles and birds, according to the generally accepted view, the intercentrum represents the united basiventralia Now, if the centrum of the atlas vertebra fuses with the axis centrum to form the odontoid process, we might naturally expect that the intercentrum belonging to the atlas vertebra should either remain with the dorsal (posterior) arch of the atlas ring or should fuse with the odontoid process of the axis, and in consequence the latter should have two intercentra instead of one, as is actually found in the dried vertebra of the adult If that be the case, the lower (anterior) portion of the atlas ring cannot be the basiventral element, although it has been generally regarded as such The details of this investigation will be published later

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Nitrogen Distribution in Kingston Cheese-Ripening

A STUDY is being made of the nitrogen distribution in Kingston cheese ripening For the determinations, methods evolved and employed by Orla Jensen, by Barthel, and by others have been drawn upon In addition, a departure has been made in the applying to this study of the method developed by Wasteneys and Borsook for the fractional analysis of incomplete protein hydrolysates Determinations were carried out on cheeses of the same 'make' from the day of making to the ninety eighth day of ripening at intervals defined

The method of Wasteneys and Borsook has been applied to the study of nitrogen distribution in Kingston cheese ripening with pronounced success Results obtained when employing the methods of Orla Jensen and of Barthel may now be complemented and illuminated for by the application of the Wasteneys and Borsook method can be defined the nature and the amount of the specific protein decomposition fractions—proteose, peptone, and subpeptone—formed as the ripening of the cheese proceeds Particularly striking is the finding that the difference in the results of the amido nitrogen determinations and the amino nitrogen determinations can be explained when interpreted in the light of data secured by the application of the method of Wasteneys and Borsook The amide nitrogen curve coincides with the subpeptone nitrogen curve, and the amino nitrogen curve is seen to superimpose itself upon the curve depicting the sum of the subpeptone nitrogen and the peptone nitrogen

In the light of the nitrogen distribution in Kingston cheese-ripening, the work of Wasteneys and his co-workers on pure proteins and specific enzymes, the classification and definition of the proteases by Willstätter, Waldschmidt Leitz *et al*, and data appearing in a study of the casein splitting abilities of certain lactic acid bacteria in chalk milk culture and of studies on the sugar-fermenting abilities of certain lactic acid bateria as influenced by defined nitrogen sources, we suggest that at the beginning of the ripening of the cheese the protein hydrolysis is of a peptic like nature, and that this peptic-like proteolysis is to be

attributed not only to the action of the rennet, but also, as our papers about to appear will show, to the elaboration of a peptic like enzyme by certain lactic acid streptococci Even within the first twenty four hours of ripening, the amount of subpeptone appearing suggests that associated with the peptic like action is a tryptic like action—a conjecture that again in the light of our cultural studies on certain other lactic acid streptococci is not without merit

Subject to qualification as further data on the nature of specific enzymes may appear, the results of our study show that after the first few hours of ripening, the proteolytic breakdown in the ripening of Kingston cheese is of an associative peptic tryptic like nature

This study of nitrogen distribution is one of a series on cheese ripening which is provided for by a research fund established jointly by the Empire Marketing Board and the University of British Columbia A detailed account of the experiments will appear shortly in the *Journal of Dairy Research*, Cambridge

BLYTHE A EAGLES
WILFRID SADLER

University of British Columbia,
Vancouver, Canada,
Mar 27

Insect Remains in the Gut of a Cobra, *Naia tripudians*

THE accompanying photograph (Fig 1) shows the remains of insects belonging to three orders namely, Rhynchota (Heteroptera Pentatomidæ), Coleoptera, and Hymenoptera (Formicoidea), found in the gut of a cobra, *Naia tripudians*, brought to us in November 1928 The cobra, which was the black variety with no markings on the back of the hood but with white

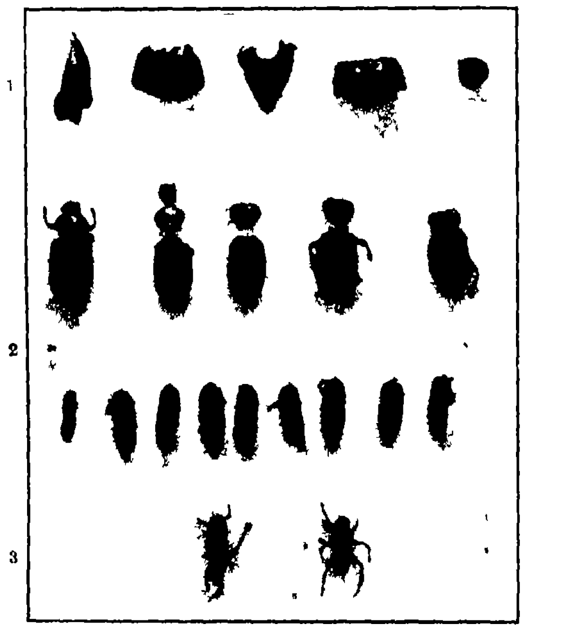

FIG 1

patches on the throat, was captured at Banting, in the vicinity of Kuala Lumpur, Selangor, F M S It was not a large specimen, since it measured only 3 ft 7½ in in length

So far as it has been possible to ascertain, records of insects having been devoured by snakes do not appear to be abundant, the only other two which have come to our notice being that of "a small ruddy beetle" found in the gut of *Tropidonotus stolatus* (Wall and Evans, *Journal Bombay Nat Hist Soc*, vol 13) and of a locust (the species not stated) eaten on one occasion by *Echis carinata* (Wall, *id*, vol 18)

The parts of the pentatomid comprise a right hemielytron, pronotum, sternum, scutellum, and pygophor The ants are ponerines and are capable of inflicting a nasty sting

We are indebted to Dr T A Buckley, Forest Department, S S and F M S, for assistance in preparing the photograph

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The Beginning of the World from the Point of View of Quantum Theory

SIR ARTHUR EDDINGTON [1] states that, philosophically, the notion of a beginning of the present order of Nature is repugnant to him I would rather be inclined to think that the present state of quantum theory suggests a beginning of the world very different from the present order of Nature Thermodynamical principles from the point of view of quantum theory may be stated as follows (1) Energy of constant total amount is distributed in discrete quanta (2) The number of distinct quanta is ever increasing If we go back in the course of time we must find fewer and fewer quanta, until we find all the energy of the universe packed in a few or even in a unique quantum

Now, in atomic processes, the notions of space and time are no more than statistical notions, they fade out when applied to individual phenomena involving but a small number of quanta If the world has begun with a single quantum, the notions of space and time would altogether fail to have any meaning at the beginning, they would only begin to have a sensible meaning when the original quantum had been divided into a sufficient number of quanta If this suggestion is correct, the beginning of the world happened a little before the beginning of space and time I think that such a beginning of the world is far enough from the present order of Nature to be not at all repugnant

It may be difficult to follow up the idea in detail as we are not yet able to count the quantum packets in every case For example, it may be that an atomic nucleus must be counted as a unique quantum, the atomic number acting as a kind of quantum number If the future development of quantum theory happens to turn in that direction, we could conceive the beginning of the universe in the form of a unique atom, the atomic weight of which is the total mass of the universe This highly unstable atom would divide in smaller and smaller atoms by a kind of super radioactive process Some remnant of this process might, according to Sir James Jeans's idea, foster the heat of the stars until our low atomic number atoms allowed life to be possible

Clearly the initial quantum could not conceal in itself the whole course of evolution, but, according to the principle of indeterminacy, that is not necessary Our world is now understood to be a world where something really happens, the whole story of the world need not have been written down in the first quantum like a song on the disc of a phonograph The whole matter of the world must have been present at the beginning, but the story it has to tell may be written step by step

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[1] NATURE, Mar 21, p 447

Rotational Constants of the Iodine Monochloride Molecule

OUR analysis of the rotation structure of the iodine monochloride absorption bands is now sufficiently advanced to permit of a fairly precise determination of the molecular constants. The region 6482–6837 A. has been measured on plates taken in the second order of a 21 ft. concave grating, and practically all the lines have been allocated to series. The strongest bands in this region are $v''=1$, $v'=8$-12; some bands belonging to the $v''=0$ and $v''=2$ progressions are also present, and there are of course two complete systems, a strong one due to ICl^{35} and a weaker one due to ICl^{37}. The figures given in the accompanying table refer to the former only.

	B_e	B_e''	α	α''	I_e	I_e''	r_0	r_e''
Cl_2	0.162 cm.$^{-1}$	0.2429 cm.$^{-1}$	0.003 cm.$^{-1}$	0.0017 cm.$^{-1}$	170 × 10^{-40} gm. cm.^{2}	113.7 × 10^{-40} gm. cm.^{2}	1.21 A.	0.988 A.
ICl	0.0869	0.1141	0.00115	0.00104	318.4	242.4	2.643	2.306
I_2	0.0291	0.0372	0.00017	0.00012	952	743	3.015	2.663

Each band consists of P, Q, and R branches, the Q being, roughly, twice as strong as the P or R. Some of the branches have been followed up to rotational quantum numbers (K) above 80, but in the neighbourhood of the origin resolution has not been found possible below $K=6$. Nevertheless, the K values may be found without ambiguity, since both initial and final terms conform accurately to the formula $BK(K+1)$ up to $K=30$ at least. Owing to the large difference between the two B's, the R branch turns very quickly (in the neighbourhood of the third line), so that only a small correction (<1 cm.$^{-1}$) will be required to convert previous measurements of unresolved heads to true band origins.

The estimated values of r_0' and r_0'' used by Curtis and Darbyshire[1] in calculating potential energy curves for the ICl molecule are respectively 0.28 and 0.32 A. lower than those now found, but since it is $(r-r_0)$ which appears in the formula used, the necessary correction may be easily made by shifting the origin 0.3 A. along the r axis. The conclusions drawn from the curves depend on their relative position and are not affected by this change.

The rotation constants are given in the table, those for I_2 and Cl_2 being included for comparison. B_0'' is a direct determination, B_0' a least squares extrapolation using the formula $B_v'=B_0'-\alpha'v'$, in which v' runs from 8 to 12.

Detailed results based on more extensive measurements will be published later.

W. E. CURTIS.
Armstrong College, Newcastle-upon-Tyne.
J. PATKOWSKI.
University of Wilno, Poland,
April 10.

[1] *Trans. Faraday Soc.*, **27**, 77; 1931.

Raman Spectrum of Solid Nitrogen Peroxide

IN the course of work on the Raman spectra of solids at low temperatures, we have succeeded in photographing the spectrum of the light scattered by solidified nitrogen peroxide (N_2O_4), at a temperature of about $-80°$ C.

The spectrum is very simple, and consists of one line having a shift of 275 cm.$^{-1}$, and is sufficiently strong to appear as an anti-Stokes as well as a Stokes line, thus confirming the allocation to the particular exciting line (Hg 4358). The material absorbs too strongly in that region for shifted lines excited by Hg 4047 to appear.

X-ray intensity measurements show that at liquid air temperatures the molecule exists as NO_2 and is in a linear form.[1] If this is true at $-80°$ C. also, the Raman spectrum would probably consist of one very strong line, corresponding to the inactive fundamental frequency associated with the vibration of the oxygen atoms symmetrically about the stationary nitrogen atom, together with a very faint line corresponding to the linear active vibration. Such an explanation of the line observed is rendered less probable by the small magnitude of the shift, which might reasonably be more of the order of that due to the corresponding vibration in nitrous oxide (N_2O) (1282 cm.$^{-1}$ in the liquid[2]). Longer exposures are being made in an endeavour to bring up very faint lines.

A. C. MENZIES.
C. O. PRINGLE.
University College, Leicester,
Mar. 31.

[1] Vegard, *Zeits. für Physik*, **68**, p. 184; 1931.
[2] McLennan, Smith and Wilhelm, *Trans. Roy. Soc. Canada*, **24**, p. 197; 1930.

Crystal Structure of Methane

IN view of the discovery by Clusius of a transformation point of solid methane at 20.4° K., it was interesting to investigate if there is a change of crystal structure or not. Heuse made a dilatometric examination of the transformation and found the very small volume contraction of 2 per mille, suggesting that the crystal structure is not altered. We have established this as a fact by making two X-ray exposures with solid methane at 21.1° K. and 18.5° K. respectively. The films were concordant within the limits of accuracy; they can be explained by assuming this structure to be a cubic close packed one, the side of the elementary cube being 5.88 A. The calculated density 0.52 is in perfect agreement with the value measured by Heuse.

McLennan and Plummer, too, in their X-ray analysis of methane, found a cubic close packed structure, with 6.35 A. as the side of the elementary cube, however, and calculated density 0.41. Moreover, the relative intensities of the lines we observed differ considerably from those given by these authors.

A more detailed account of this work will be published in the *Proceedings* of the Royal Academy of Amsterdam.

H. H. MOOY.
Leyden,
Mar. 31.

Forestry Research

I AM very glad to see in NATURE of April 4 the communications from Dr. M. C. Rayner and the Editor on this subject, and I am in cordial agreement with their remarks.

The extensive planting schemes initiated by the Forestry Commission afford a splendid opportunity for fundamental co-operative research on the building up of new forest soils. We know little enough about the soils of our native woodlands, and practically nothing about the conditions induced by planting exotic conifers on heath or grassland in our climate. It is certain that the knowledge acquired by properly planned research will save great sums of money in the future by preventing the waste of large-scale

mistakes It must be realised that except for two or three species the commercial planting of exotic conifers in Great Britain is still in the experimental stage It is essential to conduct such experiments with proper scientific control Forest botany and forest pedology have been seriously and wastefully neglected in the past by those responsible for planting schemes in this country

I should like to direct attention to a particular opportunity now available I understand that the future of the Cambridge Forestry School is at the moment under consideration That school, with proper support, would be able to initiate and carry through precisely the type of work required on the new plantations of the Forestry Commission in Breckland, and there is no other institution so conveniently situated for the purpose The Cambridge School can never hope to compete with the Oxford School, associated as it is with the Imperial Forestry Institute, in general Imperial forestry work But Cambridge is in almost an ideal position for undertaking fundamental intensive research on the Breckland forestry problems, and by doing so it will render a service of the first importance alike to science and to practical forestry It behoves all the authorities concerned to give every possible support to the well judged scheme of research which has been put forward by Dr A S Watt the University lecturer in forest botany at Cambridge

A G Tansley

Grantchester, Cambridge,
April 4

Segregation of Floral Characters in the Wild Oxlip

In quite a number of wild oxlip plants, presumably hybrids between the primrose (*Primula vulgaris*) and the cowslip (*Primula veris*), growing in situations where both the latter species abound, I find that the earliest formed flowers are borne on long peduncles of the primrose type, and are succeeded later, on the same plant, by flowers arranged on the umbelliferous type as in the cowslip Now, the question arises whether this dimorphic arrangement also occurs in *Primula elatior* (Jacq), the oxlip of East Anglia, which is regarded by some botanists as a distinct mutational variety or species If this segregation of floral characters is not found in *Primula elatior*, then this fact would favour the supposition that this species is a real mutational form and not a hybrid

The experience of field botanists working in East Anglia at this season of the year would be helpful in deciding this point So far, after the examination of some hundreds of plants, I have failed to find this dimorphic floral arrangement in any true primrose or cowslip plant The question is also important because it bears on the nature of segregation and the essential similarity of this process as it occurs in gametic and somatic cells

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April 19

The Stimulation of Spermatozoa by Drugs

I have for some years been investigating the action of drugs on mammalian spermatozoa, under the auspices of the Birth Control Investigation Committee Finding that certain drugs seemed to stimulate sperms to higher activity, I have recently made a special study of this problem I have used guinea pig sperms taken from the epididymis and suspended in a glucose saline fluid buffered at about *p*H 8 Sperms are so active when first suspended in this fluid that the effect of stimulating drugs is not obvious In these experiments the sperm suspensions were allowed to remain for 5–8 hours at the temperature of the body before the addition of the drug After 5–8 hours, the activity of the sperms was markedly reduced The drugs were tested at concentrations in the series 1, $\frac{1}{4}$, $\frac{1}{16}$, $\frac{1}{64}$ per cent, etc

Strychnine hydrochloride was found to have a marked stimulating effect at $\frac{1}{16}$, $\frac{1}{64}$, and $\frac{1}{256}$ per cent, especially at $\frac{1}{64}$ per cent For practical purposes such a poisonous substance as strychnine is to be avoided, even in minute quantities Brucine hydrochloride was therefore tried, since its pharmacological properties are similar, while it is only about one eighth as poisonous It was found to stimulate sperms markedly at $\frac{1}{4}$, $\frac{1}{16}$, and $\frac{1}{64}$ per cent, especially at $\frac{1}{16}$ per cent At this concentration brucine hydrochloride has approximately the same stimulating effect on sperms as $\frac{1}{64}$ per cent strychnine hydrochloride, yet it is only about half as poisonous Brucine therefore seems preferable for practical use Chloral hydrate was also found to stimulate sperms at $\frac{1}{16}$ per cent, but far less than brucine and strychnine

It is hoped that this discovery may find practical application in medicine and agriculture, whenever sterility is due to inactivity of sperms Perhaps its most obvious application is in cases where sperms have been sent long distances for artificial insemination, and are found to be less than normally active on arrival at their destination Further experiments along these lines are about to be undertaken

John R Baker

Department of Zoology and
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University Museum, Oxford,
April 20

Geodesy in India

On page 170 of Nature of Jan 31, 1931, appears an article entitled "Geodesy in India", by G T McC, being in the nature of a review of Geodetic Report, vol 5, of the Survey of India May I correct a small misapprehension into which the reviewer has fallen ?

In the sixth paragraph, reference is made to a decision " to re map at least a portion of the Dependency " This is not the intention The areas with which the Survey of India is concerned have been divided into a limited number of overlapping zones of 8° of latitude, to meet the military requirements In certain areas the latitude and longitude of fixed points have been converted into the corresponding 'grid' co ordinates and in some cases the grid lines have been or will be surprinted on the maps But there is no general question of re mapping at all

The width of 8° of latitude results in a variation in scale of about 1/400 or 1/800 from the average scale, and for the object in view this has been accepted as negligible However, in this orthomorphic projection it is a simple matter to apply a scale further varying with the latitude, and were this done, a much wider zone than 8° zone would give rise to little trouble or embarrassment The gain in increasing the zone width is of course reduction both in number of changes from one grid to the next and the consequential need for duplication in areas of overlap

J de Graaff Hunter

Survey of India,
Geodetic Branch Office,
Dehra Dun,
Mar 12

Cytological Theory in Relation to Heredity *

By Dr C D DARLINGTON

THE chromosome theory of heredity, by relating chromosome behaviour with the phenomena of inheritance, has obviously made it possible to apply the cytological method to the study of inheritance With this profitable field before them, geneticists and cytologists have not hesitated to draw conclusions in the one field from observations made in the other, but in order to do so they have had to apply certain rules of interpretation Their method has naturally been to assume, so far as possible, a direct relationship between cytological and genetical observations The geneticist has therefore not only assumed that the material of every part of the chromosome has a specific genetic effect, which is a widely verified assumption , but also that the capacity of the chromosome for variation is equally specific, so that it is possible to refer to hereditary differences and to particles of chromosome alike as 'genes' This second assumption is also widely verified , but it is subject to serious exceptions in that two different kinds of change have been shown to befall the same particle, namely, internal change and external change such as loss or re-arrangement This constitutes no primary objection to the theory of the gene but rather indicates a necessary enlargement of its scope

Cytologists, on the other hand, in translating their observations into genetical terms, have sought to apply the chromosome theory to the interpretation of meiosis With the help of the simple rule that the pairing of chromosomes is a criterion of their relationship, they have set to work to examine meiosis in hybrids and in ring-forming plants (such as various species of *Œnothera*) The results of these studies have been confusing because investigators have not first examined the principles they were applying to see if they were indeed principles or merely empirical rules of special derivation and therefore of limited application We now have evidence by which to test them

Meiosis consists in the occurrence of two successive divisions of a nucleus in the course of which the chromosomes divide once instead of twice as they would in two ordinary mitoses Where the distribution of the chromosomes is regular, the four daughter nuclei therefore have half the number of chromosomes of the parent nucleus (Fig 1)

At the first division, the chromosomes come together in pairs, and a whole chromosome of each pair passes to one pole to divide at the second division of the nucleus To express this comparatively with regard to mitosis, we may say that while two half-chromosomes (or 'chromatids') are associated in pairs at a mitosis, four are associated at the first metaphase of meiosis A numerical reduction in the chromosomes must be attributed directly to the lack of any splitting of the chromosomes in the interval between the two divisions of the nucleus such as ordinarily occurs But this is readily related to the fact that each chromosome is already split into the two chromatids which have passed together to one pole This in turn is related to the pairing of the chromosomes

It has therefore seemed natural (since 1890) to regard the essential difference between meiosis and mitosis as consisting in the pairing of the chromosomes Since different pairs of chromosomes pass at random to the two poles (so that A_1-A_2 and B_1-B_2 may give daughter nuclei A_1B_1 and A_2B_2 or, equally, A_1B_2 and A_2B_1), and since the chromosomes are qualitatively differentiated, it follows that those which pair and pass to opposite poles must be similar if meiosis is to yield similar reduced nuclei (Boveri) Clearly, likeness is a condition of pairing But since the chromosomes that pair can be seen to be morphologically alike and therefore to be corresponding structures derived (so far as observation then showed) from opposite parents (Montgomery), it seemed enough to say that this pairing was due to the likeness of the chromosomes An 'incipient' association is often to be seen at mitosis in the somatic cells Perhaps, therefore, meiosis was the final step in the sexual process in which the maternal and paternal elements at last united

Such is, in a general way, the 'explanation' of meiosis that is current to day To be sure, we now know that the association cannot be attributed to an attraction between chromosomes derived from opposite gametes, since pairing has been found in meiosis in parthenogenetic organisms,[1 2] and very often between chromosomes derived from the same gamete in polyploid plants It may also be objected that this is merely to explain *ignotum per ignotius* But it is still taken to be a satisfactory basis for cytological, genetical, and evolutionary deduction Incompatible observations are freely ascribed to 'mechanical' or 'physiological' conditions

There are many recent observations of this kind There are tetraploid plants (such as *Primula sinensis*[3]), the nuclei of which contain four identical chromosomes of each of the twelve types that are represented twice in the diploid These chromosomes usually associate in fours at meiosis, as they would be expected to do if likeness were the sole condition of pairing But nearly always one, two, or three of these groups fail to be formed and their chromosomes appear merely paired This is not explicable on the affinity theory The chromosomes should be either *all* in fours or *all* in pairs

Other observations of the same type are (1) The occurrence of unpaired chromosomes in triploids, instead of all three identical chromosomes of each type being associated (*Zea*,[4] *Tulipa*,[5] *Lilium*[6]) (2) The occurrence of unpaired fragment chromosomes, although these have identical mates with which they can pair (*Secale*,[7] *Matthiola*,[8] *Tradescantia*[9])

* Substance of three lectures given at the Royal Institution on Mar. 10, 17, and 24

The only difference between these fragments and the other chromosomes which pair regularly appears to be their smaller size. If the triploids are examined, it is similarly found that the chromosomes which fail to associate regularly in threes are the small ones (*Hyacinthus*[10]). Therefore, not only *likeness* but also *size* bears some relation to the pairing of chromosomes.

If now we turn to consider the structures of the paired chromosomes at meiosis we find a variety of form that shows, at first sight, neither a rule in itself nor any clear relationship with ordinary mitosis. The two processes must be studied in their development in order to be seen in relationship.

The prophase of mitosis is characterised by a linear contraction of two threads, associated side by side, to become the two cylindrical rods which constitute the metaphase chromosome. At meiosis we find at the earliest stage a difference. The threads observed are single. They soon come together in pairs side by side and reproduce the conditions observed at the prophase of mitosis very closely indeed. But on account of their pairing they are present at this pachytene stage in half the number found at the prophase of a mitosis in the same organism. Evidently, therefore, the single threads at the earlier stage were chromosomes still undivided although in the earliest visible stage in mitosis they have already divided.

After an interval, splits appear in the pachytene thread separating it into two threads, each of which is now seen to be double. But instead of these splits passing right along the paired chromosomes and separating them entirely, it is found, when they meet, that the double threads that separate in one part are not the same pair of threads that separate in another. The separated pairs of threads therefore change partners, and the points at which they change partners (there are often several distributed along the paired chromosome) are called 'chiasmata'. This stage is diplotene (Fig. 1).

Between diplotene and metaphase there is further linear contraction, and the structure of the paired chromosomes may remain the same in regard to the relationships of the four threads of which they are composed; that is, the chiasmata may remain stationary. But they may undergo a change which consists in the opening out of the loop that includes the spindle attachment, at the expense of the adjoining loops, as though the spindle attachments of the chromosomes were repelling one another. In other words, the chiasmata appear to move along the chromosome towards the ends; finally, the chromatids are associated in pairs with changes of partners only at the ends. Such changes of partners are called 'terminal chiasmata', and the frequency of the end to end unions at metaphase corresponds with the frequency of the chiasmata seen earlier, when they were still interstitial, in small chromosomes (fragments) which only have one chiasma at most.[11] Further, in organisms with large chromosomes it is still possible to see the change of partner at the end; the association is double; it is between the ends of two pairs of chromatids, not merely between the ends of one pair of chromosomes.

These observations point to the chiasmata being the immediate cause of pairing between chromosomes. How can such a hypothesis be tested? It

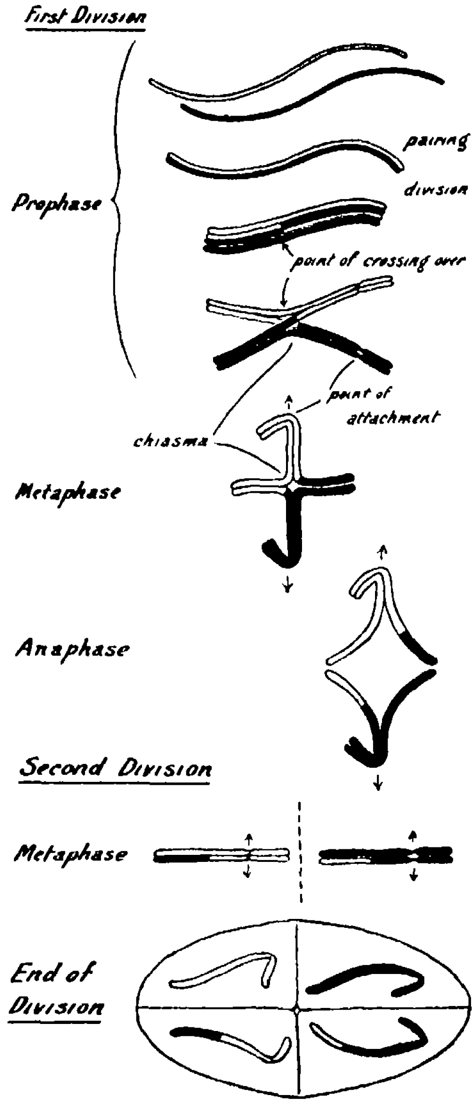

FIG. 1.—Diagram to show the development of one pair of chromosomes at meiosis and their relationship on the assumption that crossing over is the cause of chiasma formation. The four stages of prophase shown are (1) leptotene, (2) pachytene before division, (3) pachytene after division, (4) diplotene to diakinesis.

is found that given pairs of chromosomes have a constant range in the number of chiasmata formed. For example, in the *M* chromosome of *Vicia Faba*[12, 11] from 3 to 13 chiasmata are found at the metaphase, with a mean of 8·1. The *M* chromosome, which is much shorter has a range of 1 to 6, with a mean of 3·0. If we suppose that small chromosomes arising by fragmentation have a chiasma frequency proportionate to their length as compared with their larger neighbours, then we can predict from

observations of their size and of the observed frequency of chiasmata in the large chromosomes what their frequency of pairing will be, on this hypothesis Thus, in the variety "Yellow" of *Fritillaria imperialis* it was found that the chiasma-frequency was 2 58 in the large chromosomes The fragments were about one ninth of the length of the large chromosomes They should therefore have chiasmata in a frequency of 2 58/9 per pair, or 0 29 This means that they should pair in 0 29 cases (neglecting the frequency of one pair forming two chiasmata, which should be slight) They were observed to pair in 0 22 of cases [11] Here is an example of the type of observation which is susceptible of statistical analysis and supports this hypothesis

Now, if we admit chiasmata as the condition of chromosome pairing, a considerable simplification is possible in stating the relationship of mitosis and meiosis Throughout the prophase of mitosis, the threads are held together by an attraction in pairs The same rule applies to meiosis, for the evidences of failure of pairing of fragments, of odd chromosomes in triploids, and of the four chromosomes of a type in tetraploids all point to the chromosomes having no present attraction at metaphase They are merely held together by the chiasmata that is, by the attraction between the pairs of half chromosomes and the exchanges of partners amongst them, and this attraction exists equally at mitosis

This being so, we must look to the earliest stage of prophase to find the essential difference between the two types of nuclear division It evidently lies in the time at which the chromosomes split into their two halves At mitosis, it is probable that this has already happened before the chromosomes appear at prophase At meiosis, it does not happen until pachytene (possibly at the moment at which the diplotene loops appear) The prophase of meiosis therefore starts too soon, relative to the splitting of the chromosomes If we consider that there is a universal attraction of threads in pairs at the prophase of any nuclear division, as we see it at mitosis, it follows that this condition is fulfilled by the pairing of chromosome threads when they are still single, and their separation at diplotene when they have at last come to divide The decisive difference would therefore appear to be in the singleness of the early prophase threads in meiosis This singleness may be attributed to one or both of two causes (i) a delayed division of the chromosomes, (ii) a precocious onset of prophase The second of these seems the more likely explanation, on account of the short duration of the pre meiotic prophase in some animals Either assumption would account for the most characteristic of all secondary features of meiosis, namely, the exaggerated linear contraction of the chromosomes, paired or unpaired, if the time relationship of metaphase to the division of the chromosomes remains the same This hypothesis of precocity [13] may be tested by the observation of a correlation between irregularities in meiosis and (*a*) abnormality in the timing of meiosis, and (*b*) diminished contraction of the chromosomes at metaphase

The first of these tests is applicable to many organisms with occasional suppression of reduction, the aberrant nuclei enter on the prophase of meiosis either earlier or later than the normal nuclei [14 15 16 17] When they are too early, it may be supposed that a premature division of the chromosomes has precipitated the prophase, when too late, it may be supposed that the prophase has been delayed In either case the chromosomes would no longer be single at early prophase and the condition of their pairing would be lost

Such a cause of failure of pachytene pairing may be expected to be distinguishable by its effect on the contraction (the second kind of test) For when failure of metaphase pairing is not due to an upset in the timing of prophase but merely to failure of chiasma formation, we might expect normal meiotic contraction, this is the case in maize [18] Where the prophase has been delayed, we might expect an approach to mitotic conditions this is the case in *Matthiola* [19 20] Other critical evidence in favour of the hypothesis has already been quoted in these columns [21]

By trying to define in this way the relationship of meiosis to mitosis, we find out what is essential and therefore universal in meiosis, and what is unessential and secondary Only when the direct interpretation of events in the nucleus is clear (as it now seems to be) can we attempt their genetical interpretation on a satisfactory basis

Two examples of the genetical interpretation of chromosome behaviour at meiosis are of immediate importance It has been shown in every organism that has been adequately tested that crossing over can occur between corresponding parts of the paired chromosomes at meiosis, actually between the chromatids, so that crossing over in the region between *C* and *D* in a pair of chromosomes *ABCDE* and *abcde* will give four kinds of chromatid *ABCDE*, *ABCde*, *abcDE*, and *abcde* (Fig 1) We may suppose that this crossing over has no relation with anything observable cytologically that it takes place when the chromosomes are intimately associated at pachytene and has no connexion with later behaviour This view can only be taken when other possibilities are eliminated We may also assume that crossing over has some relationship with chiasmata, either as a cause ('chiasmatypy') [22 23] or as a consequence, through breakage and reunion of new threads [10 9] The last possibility has been eliminated by the statistical demonstration that terminal unions correspond in frequency with interstitial chiasmata,[11] and that the number of terminal chiasmata increases *pari passu* with the reduction of interstitial chiasmata [3 4 20] The first possibility, that the chromosomes fall apart as they come together, and that the exchanges of partners at chiasmata are therefore due to exchanges in linear continuity or crossing over between the chromatids, has been demonstrated in two ways

In tetraploid *Hyacinthus* and *Primula* associations occur with such a spatial relationship that

they can only be interpreted as the result of crossing-over [3, 25] In ring forming *Œnothera*,[28] chiasmata occur interstitially between a pair of chromosomes associated terminally with two others to give a 'figure of-eight' Such an arrangement also can arise only on the assumption of crossing over These demonstrations confirm Belling's interpretation of the *Hyacinthus* trivalents, which was not in itself indisputable [5] Whether the observations are of universal application (the simplest assumption) or not, can only be shown by cytological tests of organisms which have been studied genetically

A second problem is that of ring formation Since, on the present hypothesis, the pairing of chromosomes at metaphase is conditioned by the formation of chiasmata at prophase between *parts* of chromosomes of identical structure, it follows that ring formation (where one chromosome pairs in different parts with parts of two others) must always be due to different arrangement of parts, that is, different structure, in the chromosomes contributed by opposite parents [26, 27, 9] Thus the relationship of the chromosomes of two organisms can always be specified from the observation of the pairing behaviour of the chromosomes at meiosis in the hybrid It is therefore possible to study differences of such a magnitude as will sterilise a hybrid and are therefore not susceptible of genetical analysis This method is now being widely applied

[1] Seiler, J *Zeits f indukt Abstamm u Vererb Lehre*, **31** 1 99 1923
[2] Belar K *Biol Zentrabl*, **43** 513 518, 1923
[3] Darlington, C D *Jour Genet*, **24** 65-96, 1931
[4] McClintock, B *Genetics*, **14** 180 222 1929
[5] Newton W C F, and C D Darlington *Jour Genet*, **21** 1 16, 1929
[6] Takenaka, Y, and S Nagamatsu *Bot Mag Tokyo*, **44** 386-391, 1930
[7] Gotoh, J *Bot Mag Tokyo* **38** 135 152 1924
[8] Lesley M M and H B Frost *Amer Nat*, **62** 21 33, 1928
[9] Darlington, C D *Jour Genet*, **21** 207 286, 1929
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Landscape at the Royal Academy

IN "Cape St Vincent" (669) we have an example of the work of the late W L Wyllie in which the revered veteran showed undiminished mastery of his craft The rush of the Atlantic rollers as they mount and comb on nearing the headland will recall to many, besides the present writer, a notable incident on the voyage from England to the East

In 'Moonlight Scilly Isles' (90), Mr Julius Olsson renders with his usual skill one of the most beautiful aspects of the coastal scenery of Great Britain, and the spark of the beacon on the head land both focuses the attention of the eye and adds to the emotional appeal of the picture In "Sunlight" (130), Sir Hughes Stanton depicts a promontorial town of the Mediterranean coast silhouetted against sea and sky, a picturesque relation of architecture and Nature for which we must seek foreign shores The austerities of Spanish landscape have attracted Mr Sydney Lee (' The Ox Cart", 79), Mr Guy Kortright ("Spanish Cactus", 243), and Mr Oliver Hall ("A Town of Southern Spain", 414) In the case of several pictures which embody either the golden glow and dark shadows of evening or lurid light and sombre clouds of storm, the artists have enhanced both the height and depth of tone and colour by a frame of black and gold Notable examples of this judicious device are "The Storm" (80) by Mr Philip H Padwick, "Evening in the Mountains" (268) by Mr William Clarkson, and "Mountains near Beddgelert" (281) by Mr Oliver Hall

In the fine study of "Amiens" (258) by Mr Terrick Williams, the shadowed cathedral owes its immensity to the foreground of small houses, caught by sunlight, on the quay It is an intriguing fact that impressiveness of size should bear so little relation to that which the astronomer calls the 'apparent magnitude' of an object A notable example of the dependence of the impression of size upon grouping is afforded by Windsor Castle, which when seen above the houses of the Borough assumes the appearance of a walled town crowning the hill

In "The Estuary" (301) by Mr Arnesby Brown, we have one of the characteristic landscapes of the British coast, with fine effects of atmosphere Towering clouds fill the larger part of the picture, the horizon of the land and sea lying very low in the field of view Underlying this practice or device of pictorial composition is the singular fact that although the eye is keen to note any lateral divergence from the vertical, it receives no warning sensation of a considerable departure from level outlook Hence great sky views are not so much determined by the circumstance of there being more sky, as by a natural grouping which lures the eye to an upward outlook

In "Northleach" (479), Mr William A Rixon gives us a faithful picture of Arcadian England, the harvest field and church tower, undulating landscape, and rounded masses of spreading trees, with soft white clouds floating overhead We may travel the world over but only in England will such a scene be found This is our particular heritage, which we should cherish and preserve

In Room X, devoted to Water-Colours and Tempera, Mr Cecil A Hunt, in "Glen Brittle, Isle of Skye" (933), has rendered with poetic feeling a

andscape of Britain which stands in greatest contrast to Arcadian England, the rugged range of the Cuillin Hills, pinnacles of dark, volcanic rock, rising above mists hanging in the hollows, where shadows are suffused with the atmospheric colour characteristic of the climate of the Western Highlands

In the Architectural Room, a perspective drawing of "Sydney Harbour Bridge, Australia" (1401), Sir John J Burnet and Partners, displays the latest triumph of steel construction, one of those great lattices which, when left unenclosed by masonry, stand out so splendidly against the sun set and the dawn

The Sculpture Gallery is of particular interest to the scientific community on account of portrait busts, including that of Mr G Buckston Browne (1530) by Mr Charles L Hartwell, Lord Dawson of Penn (1592) by Mr Henry Pegram, Dr Henry S Wellcome (1513) by Mr Edgardo Simone, Sir George Makins (1550) by Mr M Pownall Bromet, Miss Joan B Procter (1624) by Mr George Alexander, and Mr Allan G Wyon's fine rendering of the striking features of the late Sir Henry Wickham (1501), pioneer planter of para rubber in India

VAUGHAN CORNISH

Obituary

PROF A A T BRACHET, FOR MEM R S

ON Dec 27 the death took place, after a painful illness of several months' duration, of Dr Albert Brachet, of Brussels, professor of anatomy and director of the Laboratory of Embryology of the Faculty of Medicine in the University of Brussels He was a foreign member of the Royal Society and *correspondant* of the Paris Academy of Sciences, and was a distinguished leader in embryological science He was also well known in circles wider than those of professional embryologists as the author of the admirable 'Traité d'embryologie des Vertébrés"

Born at Liège on Jan 1, 1869, Brachet received his early training in embryology at the hand of Edouard van Beneden Later he became pupil and assistant to Auguste Swaen In 1904 he was appointed to the chair in Brussels, where he immediately instilled new life into anatomical study in that University

Brachet's permanent place in the history of vertebrate embryology will probably rest mainly upon his investigations into the morphological facts of development His early work with his master Swaen, upon the origin of the mesoderm and vascular system in Teleosts, was followed by a series of valuable investigations upon the early development of Batrachians, and these in turn by researches along corresponding lines upon Ganoid fishes and reptiles His morphological work bears the impress of a passing phase in the history of embryological science which followed as a natural consequence the flood of uncritical morphology poured out by the enthusiasts of the first few decades after Darwin The hasty work and ill-balanced speculation of those days naturally brought in its train a spirit of disillusionment as its errors became apparent—with the deplorable incidental result that one of the most fascinating branches of biological science became reduced for the time being to the level of mere fact-collecting

Brachet was not entirely unaffected by the sterilising spirit of the day He views the process of gastrulation merely as the attainment of the two-layered condition, the ectoderm and endoderm of the embryo merely as ectoblast and entoblast—without any recognition of that splendid and inspiring idea which appreciates their homology and consequent evolutionary significance Or again, as regards that other great idea of vertebrate morphology, the protostoma theory, Brachet, while showing intimate knowledge of the actual facts of observation, will have nothing to do with the evolutionary hypothesis which alone provides an explanation of the phenomena observed, and raises them from the level of mere facts to that of constituent parts of a consistent philosophy Nevertheless, without doubt, Brachet's name will live as one of the important builders of vertebrate embryology

Like so many of his contemporaries, Brachet became eventually drawn aside from the path of morphology into the territory of experimental embryology The spirit which animated the work of himself and of his department in later years cannot be better expressed than in his own words, as quoted in the birthday notice contributed on his behalf to NATURE of Jan 3, p 41

(1) " l'analyse de localisations germinales et du déterminisme de la morphogenèse chez les Vertébrés, spécialement les Amphibiens", (2) " l'étude de la physiologie de la mise en marche du développement et des cinèses de segmentation"

Along such lines, Brachet did much careful and interesting work It is clear that the reproductive cell of a complicated animal such as a vertebrate, possessing all its potentialities for reproducing the peculiarities of the parent, down even to comparatively trivial details, must have a physiology of immense complexity, far transcending human powers of investigation, and certainly the time is not yet for evaluating finally the achievements of experimental embryology It is one of the chief merits of Brachet's admirable experimental studies on the egg of the frog that he was able to demonstrate convincingly to what an extent the substance of the egg is already differentiated in its various regions before the act of fertilisation The further conclusion he reaches as to the active part played by the spermatozoon in readjusting and fixing the localisation of the various organ-forming portions of the egg rests on a less firm foundation

Brachet was no mere laboratory recluse Endowed with a lovable personality, a high idealism, and that power of oratory that caused him to be dubbed 'the Jaurès of Anatomy', he wielded great

personal influence among the students of his university In frequent request to take the chair at sociological meetings, he became the first president of the "Socialist Intellectuals", and at his funeral the Red Flag was prominent An ardent believer in the 'United States of Europe', he was inspired on one hand by his absolute belief in the socialistic ideal, and on the other by his horror and fear of the recurrence of war

In the administrative affairs of his university Brachet also exercised much influence He served his period in the high office of Rector, and his rectorial addresses were marked alike by their eloquence and their lofty and inspiring idealism It was during this period that he obtained the immense influence and inspired those feelings of affectionate regard that made his untimely death felt as a cruel blow throughout the university community

PROF W D ZELENSKY

THE news has just reached Great Britain of the death of Prof Wladimir Zelensky, professor of zoology and head of the Parasitological Department in the University of Leningrad, which occurred on April 27, 1930, at the age of fifty years

The late Prof Zelensky was one of the prominent zoologists of Russia His investigations were devoted chiefly to the morphology, biology, and systematics of leeches, his most important contribution being the "Investigations on the Morphology and Systematics of the Hirudinea 1 The organisation of the *Ichthyobdellidæ*" (1915) Lately Zelensky was engaged on a revision of this group of leeches on behalf of the Zoological Station of Naples, and worked on the collections of leeches belonging to various Continental museums He also prepared for publication the section on leeches for the "Handbuch der Zoologie", by Kukenthal In his earlier days Zelensky established the phagocytic function of the so called 'urnæ' in the Sipunculidæ During the present dearth of biologists of the old school in Russia, the death of Prof Zelensky will be a great loss to his country

WE regret to announce the following deaths

Prof R S Heath, formerly vice principal and professor of mathematics in the University of Birmingham, on April 15, aged seventy-two years

Prof W Valentiner, formerly professor of astronomy in the University of Heidelberg, on April 1, aged eighty six years

News and Views

ON May 3 shortly before 9 26 A M, a sharp local earth shake was felt, chiefly in the coal mining district to the north west of Manchester The area in which the shock was strongly felt is about 13 miles long and 9 or 10 miles wide, and includes about 100 square miles but at one or two places outside it was also slightly felt The shock was strong enough to cause slight damage such as overthrowing chimney pots, at Eccles Irlam o' th' Heights, Patricroft, etc Tremors were recorded at the Stonyhurst College observatory, beginning at 9 h 25 m 56 s and lasting 40 sec, but not at the Godlee observatory in Manchester nor at the Bidston observatory near Birkenhead The small disturbed area (probably less than 200 square miles) and the high intensity near its centre point to a very slight depth of focus, such, for example, as the depth of the coal seams worked in the district The longer axis of the disturbed area runs about north west and south east, in the direction of the Pendleton or Irwell Valley fault and the centre of the area lies close to the fault line It is probable that the earth shake was caused by a slip along this fault, and that the slip was precipitated, not by natural causes, as in the Bolton earthquake of Feb 10, 1889, but by the removal of coal in the neighbourhood of the fault It is of some interest to notice that the disturbed area of the recent earth shake almost coincides with that of one, not quite so strong, that occurred on Nov 25, 1905, and that the places where slight damage to chimneys occurred last Sunday lie close to the centre of the innermost isoseismal of 1905, and to the centres of similar but still slighter shocks on Feb 27, 1899, and April 7, 1900 (*Geol Mag*, vol 7, p 175, 1900 vol 8, p 361, 1901 and vol 3, pp 171 176, 1906)

ON May 4 the Huxley Memorial Lecture of the Imperial College of Science and Technology was delivered in the Royal College of Science by Sir Arthur Smith Woodward, who chose as his subject "Modern Progress in Vertebrate Palæontology" A more appropriate subject or a more befitting lecturer could scarcely have been selected for this particular memorial lecture Sir Arthur, first of all, briefly recapitulated the suggested scheme for the evolution of vertebrates originally proposed by Huxley, who drew up a definite sequence from Hypichthyes (an *Amphioxus* like ancestor) to the ancestral mammals, and then attempted to find their modern counterparts In emphasising the modern research work into the question of vertebrate palæontology, Sir Arthur showed how well our modern conceptions fit in with Huxley's ingenious scheme, and how much further modern workers have gone along the same theoretical lines, based on more practical material now available For example, whereas Huxley could find no modern homologue of the Hypotheria, Sir Arthur was successful in bridging this gap, in the light of modern knowledge So much has been discovered during recent years that Sir Arthur could not help but make some definite assertions with regard to vertebrate evolution, which only a short time ago he would not have been able to make For example, amphibians and reptiles are now so closely related by known fossils that their evolutionary sequence cannot be disputed

As was to be expected from such an authority as Sir Arthur Smith Woodward, the fishes were considered very fully The result was much information concerning American workers, perhaps to the detriment

of the workers of the Old World along this line of scientific work, who have been able to bring so much to light concerning man But perhaps it was a happy thought, for, whereas much information is available concerning man, especially since the discovery of *Sinanthropus*, the work on the lower vertebrates comes as a useful complement to it Here several points of interest and importance were emphasised For example, the work of Prof E A Stensio, of Stockholm, has given us a good idea of the Myrich thyes when they dominated the world, whereas their modern counterparts, the lampreys and hag fishes, are nowhere near enough for this Bone, too, which undoubtedly was preceded by dentine, in the first place as an exoskeleton, probably followed the dentine more closely than has previously been supposed Curiously enough, too, the links between groups are nearly always of the smaller types This, with other observations, leads Sir Arthur to the conception that most probably the same characteristics were arrived at along different channels, that groups began their evolution with definite inherent aims or potentialities which are difficult to describe at present, and that the impetus to evolutionary development was not so much a struggle for existence among the animals themselves as it was between the animals and their environmental conditions

Sir John Russell gave an analysis of the relation of man to the complicated modern machinery of civilisation, in his Essex Hall lecture entitled 'Man and the Machine", delivered on April 30 Sir John pointed out that, until recently, it was the empirical method that has prevailed in our methods of agriculture Empiricism, however, gave man but an uncertain control of Nature's forces In agriculture, scientific workers have been successful in discovering the chief factors controlling the growth of plants, and Lawes, the founder of the Experimental Station at Rothamsted, about 1839, first applied this knowledge so as to increase considerably the fertility of the soil and banish the spectre of food shortage from the world The application of artificial fertilisers and bacteria specially bred for the purpose, have made better crops possible Plant diseases have been brought under control, and disasters, such as the terrible potato blight brought into Ireland about a hundred years ago, can now be avoided The geneticist has, moreover, succeeded in determining many of the characters which decide the nature or properties of plants, their height of growth, time of ripening, etc The result is that, by selection, new types of wheat have been produced with power of early ripening intensified or capable of growth in areas of subnormal rain fall Consequently, arable land has been extended into the cold northern prairies and into the old desert lands, with a great expansion in the wheat potentialities of the world In 1898, Sir William Crookes declared that the methods and knowledge then current could not long suffice to feed the growing population of the world Science and practice have advanced, and, in place of famine, wheat is so abundant that the world's granaries hold far more than can be used Other foods are similarly available more abundantly than ever In the factories, labour saving appliances have become so effective that one man can do what it took the labour of several men to do only a few years ago

We are in possession, Sir John Russell said, of a new 'machine' that easily achieves things impossible to our fathers and does much of our work for us The 'machine' calls for specialists Thus is produced the increasing army of trained men The cultural effects of the 'machine' on the wider public cannot yet be clearly seen It tends to foster passive rather than active pursuits, it is thus inimical to the arts of self expression and self development The 'machine' is reducing the demand for human labour, and by no means equally As a result, a few are overloaded with work and an increasing number find themselves unwanted This displacement of labour is a new permanent factor in our life as a community, and it must increase in importance as the 'machine' further develops The contrast between conditions in the country and the towns is striking The man in the country is much less dependent on the 'machine' than the town dweller The very low rate of unemployment in rural England is in striking contrast with that of the industrial regions, showing the greater elasticity of country life as compared with that of the towns, and Sir John Russell is of opinion that the development of country life and country pursuits affords a promising way out of our present difficulties Our ultimate aim must be to use the machine for the common good

The lecture hall of the Institution of Electrical Engineers was crowded on April 30 to hear Prof W L Bragg give the twenty second Kelvin Lecture He chose as his subject "The Architecture of Solids", and gave a popular exposition of modern theory which was much appreciated by his audience He divided solid bodies into three great classes, metals, organic substances, and inorganic substances Iron, wood, and stone are representative of these classes Metals differ from the others by the presence of free electrons, the attraction between which and the positive ions gives the structure its stability The basis of the structure of pure metals and alloys is one of close 'packing', but the radii of the atoms in metals are much greater than those of the ions in crystals The structures of pure metals are very simple X rays have proved of the greatest value in obtaining an insight into the real constitution of alloys The structure of metals and alloys can be found, but it is very difficult to picture the structure of organic substances The constitution of inorganic substances is a problem in electrostatics The stable configuration is that in which the potential energy is a minimum This enables even the constitution of very complex compounds to be found When these structures are found, we can study the effects of extension and compression on solids and the effect produced by heating them Special hypotheses have to be made in several cases, as, for example, when explaining the expansion of metals by heat Theoretically, heat should be transmitted through salt with the velocity of sound, and rock salt should be stronger than the strongest

steel Prof Bragg gave a convincing explanation of why heat travels much more slowly than this in insulating materials He regards a sheet of mica as simply an electrical condenser It has great mechanical strength parallel to the sheet and very little perpendicular to it

THE twenty first annual May lecture of the Institute of Metals was delivered on May 6 by Mr William B Woodhouse, past president of the Institution of Electrical Engineers Mr Woodhouse reviewed the development of power production throughout the world and in particular the important question of the extent to which Great Britain, dependent as it is on coal for power production, can compete with water power in other countries in the production of cheap electricity for metallurgical and other industrial purposes Electrical methods of treating ores and of producing and refining metals are used to an extent which requires very large amounts of power and is rapidly growing Electric power is being produced in Great Britain by the consumption of coal at a price which compares favourably with water power in other countries The great development of water power in other countries and the large amount still unused calls for the most careful consideration of our relative position as a power-producing country The use of oil fuel, its effect on the production and demand for coal, and the prospects of producing oil fuel from British coal, were also discussed The progress of electric power supply by a single organisation over a wide area, initiated in England some thirty years ago by the electric power companies, the developments of which have, in the face of great difficulties, provided a general supply of electricity at a low price, led the way to nationally and internationally interconnected systems of supply in all parts of the world, and in Great Britain to the establishment of the 'grid' by the Central Electricity Board It is practicable to obtain large amounts of electricity from efficient power stations in Great Britain at a price as low as one fifth of a penny a unit or even less for secondary power or restricted supplies

IN September 1929 the Government appointed a committee to consider and report upon the desirability and feasibility of establishing one or more National Parks in Great Britain, and with commendable promptitude the Report of the National Park Committee has just been issued (Cmd 3851 London H M Stationery Office 2s net) It deals generously with the terms of reference, and covers a wide range of aspects of the preservation of scenery, of fauna, and of flora The objects to be achieved by a system of natural reserves and Nature sanctuaries in Great Britain are stated to be three fold the safeguarding of areas of exceptional natural interest against disorderly development and spoliation, the improvement of means of access for pedestrians to areas of natural beauty, and the promotion of measures for the protection of flora and fauna The Committee is strongly in favour of the preservation of such areas for the public, and makes suggestions for the extension of planning powers and for the formation of regional committees which would see the necessary arrangements carried through. It distinguishes between national reserves, of interest to the nation as a whole, and regional reserves, selected for their convenience of access from industrial centres, but thinks that at the present stage it would be premature to select specific areas The variety of opinion with which the Committee had to deal is well and interestingly illustrated in the summaries of evidence which form an appendix to the Report

THE annual meeting of the members of the Royal Institution, for the election of officers and to receive the report of the visitors for the year 1930, was held on May 1 Lord Eustace Percy was elected president, Sir Robert Robertson treasurer, and Major C E S Phillips secretary In August last, the Institution suffered the loss of its president (and devoted servant), the Duke of Northumberland, a vacancy filled afterwards by the election of Lord Eustace Percy The roll of the Institution at Dec 30, 1930 comprised 944 members Of 40 members deceased, special reference is made to eight, whose average tenure exceeded fifty years Lord Balfour had been a member for sixty years The managers are in the fortunate position of being able to report the completion of the alterations to the building, involving in parts a reconstruction The house is now fully open to members, and the library books, apparatus, and equipment have been replaced The Faraday celebrations in September will therefore be held under happy home auspices Additional cause for congratulation is found in the situation that the efforts of the managers to meet the expenses of the alterations have proved successful There will be no contingent burden of debt to carry forward Besides receiving generous donations from immediate friends, the Institution has derived most timely and substantial aid from the Pilgrim Trust

IT is not the British way to allow a regularly established and accredited organisation to fail, otherwise the Royal Institution would have ceased to function, during earlier generations, in any national sense and conception The adoption of the new plan of management and activities promulgated in 1810 brought, however, permanent ideals and adherents Notwithstanding, the managers in those times endured heavy financial trials, still, they held on In 1814, during the absence of Sir Humphry Davy, "the Institution did little for science, but though poor, it strove to be fashionable" (Bence Jones) It gave "a cold collation" to the Grand Duchess of Oldenburgh on May 23 of that year The funds were not flourishing, as premised, indeed, many bills were paid out of a special benefaction fund for discharging debts Somewhat earlier, the managers had refused lectures on physiology and comparative anatomy "because they could not convince themselves that scientific lectures can be given on these subjects without offence to a part of their audience" Varied as the story is, of which present day managers of the Royal Institution must have ample knowledge, the past fluctuations of

the establishment provide stimulating thought and instruction Faraday gave his first lecture within its walls in 1824

A NOTEWORTHY feature of the Safety Week arranged by the National Safety First Association, which is to be held in Leeds on May 11 16, is the chemical session arranged for Tuesday, May 12 This session, at which Dr E F Armstrong, chairman of the Association of British Chemical Manufacturers and of its Works Technical Committee, will preside, is open not only to members of the chemical and allied industries but also to representatives of all firms which are members of the National Safety First Association The Association of British Chemical Manufacturers has already been responsible for much valuable work in regard to safety in the chemical industry A series of *Safety Circulars*, giving information on accidents occurring from time to time in chemical industry, and indicating precautions which may be taken to avoid their repetition, as well as a quarterly summary of safety literature, are regular features of the Association's activities In addition, the Works Technical Committee has already issued Part 1 of "Model Safety Rules for Chemical Works", and a first section of Part 2, dealing with fire and explosive risks

AT the chemical session on May 12, Mr J Davidson Pratt, general manager of the Association, will present a paper on the cleaning and repair of vessels containing dangerous materials This is a subject of interest to almost every industry and neglect or ignorance of the precautions to be used in cleaning or repairing containers, particularly those used for organic solvents, has been responsible for numerous accidents, many of which have been fatal The incidence of such accidents is far from being confined to chemical industry, where the necessary precautions are indeed comparatively well known and observed, and one of the fundamental problems of industrial safety is indeed here encountered—that of securing the dissemination of the safety information in every quarter where it may be of use The Leeds meeting provides a valuable opportunity for the consideration of an important safety problem, and a good attendance should ensure that the principles to be observed in handling such containers are made known in quarters not otherwise easily reached

AT a meeting of the International Executive Council of the World Power Conference of 1929 the need for a comprehensive and authoritative survey of current literature on power, fuel, and related subjects was recognised and a sub committee appointed by the British National Committee considered the suggestion Its report was unanimously approved at the meeting held in Berlin in June 1930 It was suggested that a bulletin be prepared, with the following recommendations (1) Each country to abstract its own literature, the abstracts to be in English, French, or German, (2) the abstracts to be indexed in accordance with the Universal Decimal Classification, (3) the arrangement of the abstracts to follow that in use by the Institut international de Bibliographie, to be printed on one side of the paper only, and to be capable of being mounted on 5 in × 3 in cards This last recommendation is a good one, since it allows for either binding annually or a card index system The first number of this *Power and Fuel Bulletin*, published by the British National Committee, has recently appeared The abstracts are grouped under four main headings—(*A*) sources (fuel, water, wind), (*B*) generation (steam, electricity, water, mechanical power), (*C*) distribution and storage (steam, electricity, water, gas, oil, pneumatic), (*D*) utilisation The following organisations are co operating in the compilation of the bibliography Fuel Research Division, Department of Scientific and Industrial Research, British Chemical Plant Manufacturers' Association, British Electrical and Allied Manufacturers' Association, Institution of Petroleum Technologists, National Federation of Iron and Steel Manufacturers, and the National Gas Council of Great Britain and Ireland The *Bulletin* will be published monthly, and the subscription is ten shillings for twelve issues A copy of the first number and a subscription order form will be sent, post free, on application to the Honorary Secretary, British National Committee of the World Power Conference, 63 Lincoln's Inn Fields, London, W C 2 The National Committees in Czechoslovakia, Germany, Japan, and Poland have also begun publication, or will do so in the near future

AN instructive article appeared in the *Times* of May 1, concerning two new research stations, of much importance to the deep sea fishing industries of the British Empire, which have been founded in Newfoundland and Scotland The Newfoundland station, which is being set up jointly by the Newfoundland Government and the Empire Marketing Board at Bay Bulls (near St John's), starts operations this spring The Torry station, under the Department of Scientific and Industrial Research, and also financed largely by the Empire Marketing Board, has been in existence at Aberdeen for a little more than a year These two stations represent the latest endeavours to organise and conduct scientific investigations on two great problems with which the modern fishing industries are confronted Newfoundland, as a great exporter of fish, will be served by the scientific workers at Bay Bulls in the search for a fuller knowledge of the great natural fluctuations in yield of the fisheries for cod and other economically valuable fish, knowledge which will render possible the establishment of an effective intelligence service for recording the movements, quantities, and quality of the fish shoals upon which the fishermen depend At Torry, on the other hand, efforts are being directed towards the perfecting of methods designed to preserve the catch in the best possible condition as food and in a form which will appeal to the palate of the consumer Success at Bay Bulls will free the producer from the present trammels of uncertainty in yield, while good work at Torry will facilitate the successful exploitation of far distant fishing grounds, and ensure to the consumer a better and more acceptable food commodity

IT is pointed out, in a recent *Daily Science News Bulletin*, issued by Science Service, Washington, D C,

that the route of the proposed Nicaraguan canal lies almost directly across the epicentre of the earthquake that ruined Managua on Mar 31 That epicentre lies in lat 11 9° N long 86° W, close to the north western end of Lake Nicaragua Another shock of similar intensity from the same origin might cause great damage to canal locks and power houses, or to the canal itself by landslides It is worth noticing, however, that in all excavations, the intensity of an earthquake is much less than on the surface This fact has frequently been experienced in railway tunnels and in mines, and even at the bottom of pits 10 18 ft deep as was shown by measurements made in Japan about forty years ago by Milne, Sekiya, and Omori (*Trans Japan Seis Soc* vol 10, pp 25 26, 36, 1887, and vol 16, pp 19 45, 1892)

ADMIRAL D W TAYLOR U S N and Rear Admiral Sir Douglas Brownrigg Bart, have been elected honorary vice presidents of the Institution of Naval Architects

AT the meeting of the Royal Society on May 14 there will be a discussion on "Ultra penetrating Rays" The discussion will be opened by Prof H Geiger, of Tubingen, followed by Lord Rutherford and others

THE centenary of the birth of David Edward Hughes (May 16 1831) will be commemorated at the Institution of Electrical Engineers on May 14, when a short discourse on the life and work of Hughes will be delivered by Mr Sydney Evershed

THE sixteenth Guthrie Lecture of the Physical Society will be delivered by Sir Richard Glazebrook, who will take as his subject "Standards of Measurement, their History and Development" The lecture will be delivered at 5 15 P M on Friday, May 15, at the Science Museum South Kensington

THE Carnegie Gold Medal of the Iron and Steel Institute has been awarded to Mr E Valenta, of the Skoda Works Pilsen, for his work entitled Heat and Acid resisting Cast Iron with High Chromium and Carbon Content"

BY his will, the Hon Sir Charles Algernon Parsons, who died on Feb 12, aged seventy six years bequeathed £4000 to the North East Coast Institution of Engineers and Shipbuilders, £3000 to the Armstrong College, Newcastle, £3000 to the Royal Institution of Great Britain, and £2000 to the British Association

THE second Spiers' memorial lecture of the Faraday Society will be given by the president, Dr Robert L Mond, on June 17, at the Royal Institution The lecture will be entitled "Michael Faraday", and tickets for admission may be obtained from the Secretary of the Faraday Society, 13 South Square, Gray's Inn London, W C 1

THE Geological Society of London will hold a conversazione in the Society's apartments in Burlington House on June 3, from 8 30 to 11 P M During the evening, Dr W F Whittard will describe the geological work of the Cambridge expedition to Greenland in 1929

AT a dinner of the Society of Apothecaries on April 28 Sir Stanley Hewett, Surgeon Apothecary to the King, was presented with the diploma of the Society (*honoris causa*) This is the third time only that the honorary diploma has been presented, the other two having been awarded to the Prince of Wales and Sir John Lynn Thomas, consulting surgeon of King Edward VII Hospital and to the Welsh National Memorial Association

THE Council of the Institution of Civil Engineers has made the following awards in respect of papers read and discussed at the ordinary meetings during session 1930–31 A Telford Gold Medal to Mr W T Halcrow (London), Telford Premiums to Mr F R Freeman (London), Mr G C Minnitt (Bombay), jointly to Mr C S Berry, Mr H P Gaze, and Mr C E H Verity (London), and jointly to Prof A H Gibson (Manchester), Mr T H Aspey, (Wigan), and Mr F Tattersall (London), a Manby Premium to Mr A R Ellison (Nag Hammadi, Egypt), a Crampton Prize to Mr R T McCallum (Derby), the Council would have awarded a Telford Premium to Mr Percy Allan (Sydney, N S W) had he been still living

THE Dorothy Temple Cross Research Fellowships in tuberculosis for the academic year 1931-32, for persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms", will be awarded shortly by the Medical Research Council Candidates must be British subjects and possess suitable medical, veterinary, or scientific qualifications The fellowships will preferably be awarded to those who wish to conduct inquiries outside Great Britain They are generally awarded for one year, and are of the value of not less than £300 per annum, with travelling expenses in addition It may also be possible to award a Senior Fellowship of considerably greater value to a specially well qualified candidate wishing to undertake an intensive study of some particular problem of tuberculosis at a chosen centre of work outside Great Britain Particulars and forms of application, to be returned before June 6, are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A director of the Research Institute of the Cancer Hospital, Fulham Road—The Secretary, Cancer Hospital, Fulham Road, S W 3 (May 11) An assistant master for mathematics and electrical engineering in the Junior Technical School for Boys of the Paddington Technical Institute, and for evening classes—The Education Officer (T 1), County Hall, S E 1 (May 16) A technical assistant under the Department of Scientific and Industrial Research, for abstracting work in connexion with fuel research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen

Street, S W 1 (May 18) A technical assistant in the department of economics of the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (May 18) An assistant tutor for adult education in rural districts, principally, in North Lancashire under the Lancashire Education Committee—The Director of Education, County Offices, Preston (May 20) An assistant lecturer in mathematics at Westfield College—The Principal, Westfield College, N W 3 (May 27) A principal of Brierley Hill Technical Institute—The Director of Education, County Education Offices, Stafford (May 27) A student probationer (zoologist or physiologist) at the M B A Laboratory, Plymouth—The Director, Marine Biological Laboratory, Plymouth (May 29) An assistant lecturer in the department of mathematics of the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (May 30) A professor of pathology in the University of Hong Kong—The Chief Medical Officer Ministry of Health, Whitehall, S W 1 (June 24) A part time lecturer in engineering production and works management at Battersea Polytechnic The Principal, Battersea Polytechnic, S W 11 A biology master at Haileybury College—The Master, Haileybury College, Hertford

Our Astronomical Column

The Siberian Meteor of June 30, 1908—The *Scientific American* for April contains a note by J G Crowther on the above meteor, which is undoubtedly the most remarkable one on record It will be remembered that many square miles of forest were levelled, thousands of reindeer killed, and that a blast of hot air was felt by people at a considerable distance from the fall Mr Crowther now reproduces barographs taken on that day at five stations in England, they all show a series of well marked oscillations, at times that get later as they are farther from the place of the fall The deduced velocity is about that of sound, and the time of travel from Siberia to England is 5 hr 10 min, which is about right for a sound journey of 3550 miles Hence there is little doubt that the oscillations indicate air waves produced by the fall

There is, however, a further phenomenon, that evening there was a remarkable, red sunset glow which lasted all night At midnight it looked like the glare of a distant conflagration A photograph of the Greenwich Naval College was taken from the Royal Observatory at midnight by the light of the glow It was discussed at the meeting of the British Astronomical Association on July 1 (see *Jour Brit Astr Assoc*, **18**, No 9, p 354) Mr H P Hollis said "About half past nine as seen from Greenwich, it did not differ much from a fine sunset, except that the luminosity was more to the north than sunset effects usually are, but the appearance lasted, and at one o'clock had shifted a little to the east, being if anything rather more brilliant than it had been earlier But the most remarkable thing was the light over the whole of the northern sky, which was then as bright as the southern sky is when there is full Moon "

The writer of this note remembers that at the time he compared the phenomenon with those that followed the eruption of Krakatoa in 1883, and suggested that there might have been an eruption in some little known region But it now appears that it was probably due to dust raised by the meteor, and carried westward by the same rapid current in the upper air that carried the Krakatoa dust so quickly round the world The speed would be 185 miles per hour Mr Crowther records that at 7 P M on June 30, Mr de Veer, of Haarlem saw "an undulating mass to the north west, it was not cloud for the blue sky itself seemed to undulate"

The meteor may have belonged to the Pons Winnecke swarm, but it could not (as is erroneously suggested in the article) have been the comet itself, as that passed perihelion on Oct 9, 1909, so that it was a long way from the earth in June 1908

Temperatures of the Sun, Moon, and Mars—Prof H N Russell gives in the *Scientific American* for April an account of recent researches at Mt Wilson by Messrs Pettit and Nicholson using a delicate thermopile on the 100 inch reflector They find for the moon's surface under a vertical sun the temperature 101° C, just above boiling water, at altitudes 60°, 30°, and 10° the temperatures are 88°, 40°, and −30° respectively They studied the effect of an eclipse of the moon, finding that a region that was at 60° C before the eclipse began, fell to −100° when the region entered the umbra, the return of heat after the eclipse was also rapid, suggesting that the moon's surface is composed of loose volcanic ash and that the heat only penetrates a few inches below the surface The temperature at night is concluded to fall below −150° C There is thus a range of 250° C between day and night in the equatorial regions of the moon, this would tend to disintegrate rocks by alternate expansion and contraction, as R A Proctor pointed out fifty years ago New observations on Mars indicate that with an overhead sun in perihelion the temperature is 18° C The temperature at the pole at the end of summer is about the same Observations of sunspots gave for their temperature 4750° K, or about 1200° cooler than the surrounding photosphere This refers to the middle of the disc, where vision penetrates to a lower layer in the sun than with oblique rays

Perturbations of Wolf's First Periodic Comet—*Circular* No 10 of Warsaw Observatory contains a summary of Prof M Kamienski's exhaustive researches on the motion of this comet from 1884 to 1919 The comet was observed at every return in this interval, except that of 1905 After the perturbations of all the planets except Mercury and Neptune have been carefully computed and applied, there are several fairly large residuals, amounting in seven cases to 14″ or more It is shown that these can be greatly reduced by the assumption that the mean daily motion of the comet is diminishing by the amount 0 00000042″ per day, this is in addition to the changes due to planetary perturbations There is now one residual of 6″, one of 5″, the remainder are less than 4″ The mean residual is reduced from 6 5″ to 1 8″ The author points out the similarity to the case of Encke's comet, found by Prof O A Backlund to have an increasing mean daily motion De Sitter's value of the mass of the system of Jupiter was used, it is 1/1047 40 Incidentally, the result supports de Sitter's conclusion that it is better not to use results based on comets in adopting the mass of Jupiter, since these are subject to unexplained anomalies

Research Items

Art of the Bush Negroes of Dutch Guiana—For some years, Dr Morton H Kahn has conducted expeditions to Dutch Guiana on behalf of the American Museum of Natural History, with the object of investigating the culture of the descendants of the West African Negro slaves who revolted from the Dutch in the seventeenth century, and have remained practically untouched by white or Indian influence ever since He has now contributed to the *Journal* of the Museum an advance account of their art in anticipation of a book on these people which he is about to publish Their art is a well developed highly conventionalised form with considerable social significance Common objects of every day life are developed by carving into highly elaborated forms Combs, paddles, stools, and other objects show great beauty of form and design with a sense of line and balance The carving is done by men, and the objects have a ceremonial significance, for these wooden pieces are tokens of love Though the people are largely promiscuous, there is a certain amount of wooing necessary, which is done by means of the presentation of a carved object A woman is, therefore, proud of her collection of carved objects and does not part with them readily, for each piece is the token of the affection of a male As a skilful carver is held in considerable repute, and those who are not skilful must obtain their services by trading game or fish, wood carving is practised assiduously from boyhood The carved objects are made of hard jungle wood, some of lignum vitæ, those of light wood not being popular The carving is done with a jack knife and a pair of compasses and finished with matted grass and river sand The objects are not used for trade purposes Colour other than that natural to the wood is not usually shown, though occasionally inlay of other woods is employed The objects are sometimes so highly carved as to be useless The symbolism of the designs is individual Prominent motives are the snake, the vulva, and the human scapula

Ecological Methods and the Tsetse Problem—In *Ecology*, vol 11 (1930), pp 713 733, Dr J F V Phillips discusses the application of ecological methods to a better understanding of the behaviour of the tsetse fly (*Glossina* spp) in Tanganyika Territory At least 60 per cent of the country is either lightly or densely infested by various species of *Glossina*, the most important being *G morsitans* and *G swynnertoni* In 1925 funds became available, through the Tsetse Subcommittee of the Committee of Civil Research, for the establishment of a special department for the scientific study of the vectors of trypanosomiasis and its organisation upon lines of modern ecology The detailed application of the latter method, it may be added, is under the direction of Dr Phillips The conception of the plan of campaign is based upon the fact that tsetse flies are associated in varying degrees not only with the specific animals upon the blood of which they feed, but also with vegetation communities The tsetse fly investigator requires, therefore, to be versed both in the purely entomological aspects of the problem, and also to have a knowledge of the relationships of the biotic communities whereof the insect is a constituent It would appear that a productive method of helping to solve the menace of these insects lies in an understanding of its ecology The principal lines of investigation include the detailed study of the insects in relation to the physical and biological characters of their environment, their interrelations with the vertebrate fauna, their biological control and the experimental alteration of the biotic and physical characters of selected areas These and other aspects of this great problem are discussed in this paper which outlines a comprehensive and far reaching plan of campaign

Fauna of the Dutch East Indies—The scientific results of the expedition of the Prince and Princess Leopold of Belgium accompanied by Prof Van Straelen in 1929 (Résultats scientifiques du Voyage aux Indes Orientales Néerlandaises de LL AA RR le Prince et la Princesse Léopold de Belgique, publiés par V van Straelen, Directeur du Musée Royal d'Histoire Naturelle *Mémoires* du Musée Royal d'Histoire Naturelle de Belgique) are being published handsomely in quarto form, eight parts of which have been issued in 1930 These cover a wide field, and each is written by an expert Vol 2 contains "Suesswasserschwaemme", fas 2, by Walther Arndt, "Cœlentères hydropolypes", fas 3, by E Leloup, "Schyphomedusen", fas 4, by G Stiasny, and "Oligochæten", fas 5, by W Michaelsen vol 3 includes fas 1, "Isopoda (excl Oniscoidea and Epicaridea)" by A F Nierstrasz, and "Isopoda Epicaridea" by H F Nierstrasz and G A Brender a Brandis, fas 2, "Parasitic Copepoda" by W H Leigh Sharpe, and fas 3, "Cirripedes" by C A Nilsson Cantelli—vol 5, fas 1, containing "Batraciens" by S F de Witte The most comprehensive are the parts on the oligochætes and the Crustacea, fourteen species of cirripedes being recorded from various parts of the Malay Archipelago, including a new genus and two new species, two new species of parasitic copepods, and some interesting new isopods The oligochætes collected belong mostly to the large genus *Pheretima*, and these are very carefully worked out Most of the papers are illustrated by text figures, but there are line drawing plates in Leigh Sharpe's "Parasitic Copepoda" and photographic plates in Leloup's "Hydroids", all of which are good

Growth of Lobsters—An appendix to the *Interim Report* (Report on Crabs, 1930) of the Interdepartmental Committee on Crabs and Lobsters (London H M Stationery Office), by Mr Richard Elmhirst, brings out some interesting facts with regard to the growth of lobsters The growth curves from all available data show that a three year old lobster is about 110 mm long These data are from lobsters reared in captivity and also from those marked and recaptured After about seven years the growth is slow At about ten years old the males and females are of equal size, but nearly all very large lobsters are males At first the females grow faster than the males, but when maturity sets in the growth is slower Weighing experiments which have been undertaken at the Millport Laboratory, especially with reference to the increase of weight at moult, show that this increase may be as much as 30 per cent, but exceptional cases are cited and one lobster was actually lighter after the moult The cast shell is eaten by the lobster, even if this is withheld for some time There is no relation between the weight of exuviæ consumed and the increase of weight during the shell eating period, the lime taken in during hardening probably replacing water in the skin The data available show that the inter moult increase is about 10 per cent in males and 8 per cent in females Tables are given showing details both of lengths and weights

***Parapseudecheneis*, a New Genus**—Dr Sunda Lal Hora and Dr Paul Chabanaud have studied the siluroid fish *Pseudecheneis paviei* in much detail, and find that it is undoubtedly not congeneric with *Pseudecheneis sulcatus*, the only other species ascribed

to the genus In their paper "The Siluroid Fish *Pseudecheneis* and an Allied New Genus" (*Records* of the Indian Museum, 32, 3, Oct 1930) they describe the characters of both genera *Pseudecheneis* and *Parapseudecheneis* both have an adhesive apparatus composed of a series of transverse lamellæ resembling in superficial appearance and form the adhesive disc of *Echeneis* or *Remora*, but they are quite different in general form, especially in the head region It is suggested that both genera are derived from those members of the genus *Glyptosternum* which live in calm and placid waters of the highlands of Central Asia The fact that the pectoral fins are placed somewhat higher than the ventral surface of the body shows that they have taken to life in rapid waters comparatively recently, and that their ancestors were probably well adapted for life in deep and calm waters *Pseudecheneis* and *Parapseudecheneis* appear to have been evolved from two different stocks, but, under the influence of the current, have developed a similar type of adhesive apparatus

Larch Poles for Transmission Lines—Experiments have been carried out at the Forest Products Research Laboratory at Princes Risborough in the treatment of home grown larch poles to render them suitable for use in telegraph, telephone, and power transmission lines The objections to larch (which for many purposes has long been held in high repute in Great Britain) for transmission lines are apparently based on the behaviour of creosoted poles used during the War It was recorded of those poles that the creosote did not penetrate the pole to any depth when subjected to the methods of treatment then in use, consequently after erection the poles were liable to crack or split severely Experiments carried out with consignments of poles from the well known larch woods in Tintern Forest have shown that with suitable treatment these difficulties can be overcome By peeling and making a number of incisions in the poles with a broad knife, a satisfactory penetration of the preservative is obtainable Although the incisions have a slight weakening effect on their strength, home grown larch poles so treated are said to be 25-30 per cent stronger than imported poles of Scots pine of the same dimensions Provided, therefore, that the larch poles are grown as clean as the imported pine, they should easily be able to hold their own in competition *Bulletin* No 8 of the Forest Products Research Laboratory (Jan 1931), recently issued by the Department of Scientific and Industrial Research, gives full technical details of the experiments carried out

The Old English Mile—In a paper recently published in the *Geographical Journal*, Sir Charles Close showed that the mile in use in the fourteenth century in England was not less than ten furlongs Lieut Col J B P Karslake returns to this matter in the *Geographical Journal* for April, and shows that the old English mile was actually eleven furlongs This can be proved to be the mile of 1500 paces It was identical with the *leuga*, the common unit of maximum linear measurement in early Saxon times It was introduced into England in the first century B C, and it is the measurement that was used in the Domesday survey Apparently it was replaced by the mile of eight furlongs by the use in Saxon times of the Roman mile of 1000 *passus*, divided into eight *stadia* So early as the ninth century, the *stadium* became the equivalent of the furlong This mile of eight furlongs was adopted by the Post Office on its establishment in the reign of James I for the determination of rates of horse hire for postal purposes Thus milestones eight furlongs apart were set up, and this mile became the accepted standard of measurement in Great Britain

The Labrador Current—In a report on the coastal waters of Labrador based on explorations in 1926 (*Proceedings* of the American Academy of Arts and Sciences, vol 66, No 1), Mr C Iselin directs attention to certain features of the Labrador current revealed by sections across its waters Two sections showed that the colder water is separated from the coast by a band of fresher warm water derived from land drainage, and that the coldest water in the current lies at a depth of about one hundred metres A further comparison with sections of the current taken some years ago in Davis Strait shows that the current keeps practically the same temperatures and salinities throughout A cross section in Davis Strait gives 10 square miles of water below 0° C, and a cross section off Sandwich Bay in the south of Labrador gives a comparable figure of 12 45 miles The temperature of the body of the current (−1° to −1 5° C) is maintained by scanty solar warming, the shortness of the summer, and the melting of bergs and floes, which hinder any rise in temperature Mr Iselin points out how the water supply from the surface of Labrador supplies an urge for the current, just as he believes that the chief source of the current is the urge supplied in Baffin Bay by land drainage and the northward setting West Greenland current Low salinity, in spite of low temperature, gives a reduced salinity on the west of the bay The eastern side has a higher salinity by the inflow of Atlantic water This difference forces the western waters southward

Magnetic Analysis of α-Rays—An article by S Rosenblum in the December number of the *Journal de Physique*, on recent progress in the study of the magnetic spectra of α rays, contains some details of the apparatus by means of which he was able to show that certain α rays, for a long time accepted as simple actually consisted of discrete groups The magnet employed was the large one of the Paris Academy of Sciences The largest pair of pole pieces used had a diameter of 75 cm, and gave a constant field of 24,000 gauss over a region 35 cm in diameter, which was adequate to enable him to apply to α particles the focusing method with large deviations that had already been used with much success with β particles by Ellis, Meitner, and others The paper contains several interesting photographs of apparatus, as well as a number of reproductions of the magnetic spectra of the α rays from thorium C

Past and Future in Quantum Mechanics—In a short communication appearing in the second March issue of the *Physical Review*, Prof A Einstein, R C Tolman, and B Podolsky have raised the question of whether or not the quantum mechanics limits knowledge of the past path of a particle in the same way that it does knowledge of its future The test is made by consideration of an idealised experiment of a type now familiar in demonstrations of the uncertainty principle The history of two particles proceeding from one region of space to another by different routes is followed out in detail, and, to avoid a paradox in connexion with measurement of time and energy, it is first shown that momentum cannot be determined without changing its value, and then the original problem is decided in the negative A final remark is added to the effect that it is desirable to emphasise that quantum mechanics imposes limitations on the localisation in time of a macroscopic phenomenon like the opening and closing of a shutter

Reduction of Potassium Perrhenate—Noddack, one of the discoverers of the new element rhenium, found that the yellow oxide, Re_2O_7, when heated in sulphur dioxide, was reduced to a blue oxide of indefinite composition, and this when heated in

hydrogen gave a black oxide ReO_2. This was not obtained with milder reducing agents on a perrhenate solution, these yielding a yellow solution which when made alkaline with barium hydroxide gave a yellow precipitate believed to be barium rhenate. The yellow solution was believed by Noddack to be rhenic acid. In the March number of the *Journal of the Chemical Society* Briscoe, Robinson, and Stoddart describe experiments which show that the first light coloured product of reduction is a colloidal suspension of the black material which it afterwards yields. This black product is $ReO_2 \cdot 2H_2O$, and can be obtained quantitatively from the perrhenate, a reaction reminiscent of that by which the black reduction product of osmic acid, namely, $OsO_2 \cdot 2H_2O$, is produced. No evidence of the formation of rhenic acid or the precipitation of barium rhenate was obtained. The action of various reducing agents under varying conditions is described in the paper. The hydrate $ReO_2 \cdot 2H_2O$ when heated at 250° for twelve hours in an evacuated tube gave the anhydrous oxide, ReO_2, in the pure state.

Cosmic Rays.—M. F. Baldet contributes to *L'Astronomie* for March an interesting review of the progress of knowledge about these rays. So far back as 1903, Rutherford and McLennan had noticed the tendency of electroscopes to lose their charge; they thought that this might arise from gamma rays of terrestrial origin. To test this, an electroscope was carried up to a great height by a free balloon in 1910; it was found that the loss of charge was more rapid than on the ground, suggesting that the rays had a cosmic origin. Prof. Millikan discovered in 1913 their remarkable penetrating power, finding that it needed 20.8 metres of water or 1.8 of lead to quench them. It was inferred that their wave-length was only 1/50 of that of the gamma rays. It was shown that the rays did not come from the sun, since there was no appreciable difference between the strength by day and by night. When Prof. Størmer traced auroræ to the impact of electrons from the sun, it was thought that these rays might arise in a similar manner; accordingly Prof. Millikan made an expedition last year to Hudson's Bay, near the magnetic pole; there were bright auroræ on three nights, but the strength of the cosmic rays was no stronger than at Pasadena. It was concluded that they are not connected with the aurora. A slight tendency has been found for the strength of the rays to vary with the barometer; this is explained by atmospheric absorption, since the barometer measures the mass of air above the place. M. Baldet goes on to explain Prof. Millikan's suggestion that these rays may have their origin in the coming together of hydrogen atoms in space to build up more complex atoms; such transformations would be accompanied by an emission of energy. Sir James Jeans prefers to explain them by the annihilation of protons and electrons, showing that this would give rays of the right wave-length.

The Antimony Electrode.—The electrode consisting of metallic antimony in a solution containing solid antimonous oxide (Sb, Sb_2O_3) has been used in electrometric titrations and can be applied in cases where the hydrogen and quinhydrone electrodes do not function satisfactorily. It has also been used to measure pH values. In the March number of the *Journal of the Chemical Society*, Britton and Robinson describe experiments made with the object of determining the scope of the electrode as a titrimetric indicator and the extent to which the electromotive forces may be accurately converted into pH values, previous researches on the latter not being in good agreement. The work dealt with acids (including hydrocyanic acid) and salts which could not be titrated in the presence of the hydrogen or quinhydrone electrode. The results show that the antimony electrode possesses a wide range of applicability and is capable of rapidly indicating prevailing pH values with a moderately high degree of accuracy. A single universal buffer solution was employed, composed (according to the work of Prideaux and Ward) of a mixture of phosphoric, phenylacetic, and boric acids, each 0.04 molar, neutralised with 0.2 normal sodium hydroxide. Rods of pure cast antimony, cleaned with emery paper at the beginning of each titration, and purified antimonous oxide added to the buffer solution, were used, but it was found that addition of the oxide was unnecessary. Vigorous mechanical stirring is essential.

Flame Temperatures.—Jones, Lewis, Friauf and Perrott in the March number of the *Journal of the American Chemical Society* record measurements of the temperatures of hydrocarbon flames made at the Pittsburgh station of the U.S. Bureau of Mines. The method used was the reversal of spectrum lines of sodium and lithium salts in the flame, a heated tungsten strip examined by an optical pyrometer providing the light transmitted through the flame. The flame temperature increases rapidly, starting with a mixture near the lower limit of inflammability, and reaches a maximum with a gas-air mixture containing combustible slightly in excess (due to dissociation of the products) of that requisite to consume all the oxygen present. With further increase in percentage of combustible the flame temperature falls again, although not so sharply as for mixtures containing excess oxygen. The maximum flame temperatures of the gases tested vary from 1880° for methane to 1975° for ethylene; the maximum variation for the different hydrocarbons is less than 100°. The maximum flame temperatures of the unsaturated hydrocarbons (ethylene, propylene, butylene) are higher than those of the saturated hydrocarbons (methane, ethane, propane, butane, isobutane). The combustible-gas-air mixture which gives the highest flame temperature does not correspond to that which gives the highest speed of uniform propagation of flame, except for methane and possibly Pittsburgh natural gas. In other cases the mixtures for highest flame temperature contain less combustible gas. Attempts to calculate the flame temperatures, making use of specific heats, gave satisfactory results, the temperatures being 100° higher for the unsaturated and 40°–70° higher for the saturated hydrocarbons, in such a direction as to account for the difference by radiation losses from the flame.

Deformation of a Single Crystal of Silver.—A normal sample of silver consisting of an aggregate of crystals when worked and annealed is known to twin readily. This metal was, therefore, chosen by Gough and Cox (Institute of Metals, annual general meeting, Mar. 11) to investigate the formation of such twins in a single crystal. After being subjected to alternating torsional stress, however, no definite twin markings were to be observed, though the surface was covered by slip-bands on octahedral planes and in good agreement with the maximum shear stress hypothesis of elastic failure. After complete fracture, the specimen was vacuum annealed without, however, any twins being produced. Under compressional stress, both static and dynamic, the same result was obtained. The complete failure to produce twins in these experiments must be held to constitute proof of an essential difference of the mode of deformation between the single crystal and an aggregate.

Climatological Literature and Research

PROF. R. DeC. WARD'S recent paper, entitled "The Literature of Climatology"[1] deserves to be brought to the notice of English readers. It is an attempt, in so few as eighteen pages, at a survey of the various lines along which climatological research has been carried out, and of the literature available in each branch. There are a number of branches of science—for example, biology, medicine, and engineering—in which a research worker is sometimes confronted with the need for information about the climates of different parts of the world, and the precise kind of information required varies with the nature of the research work that is being done.

Prof. Ward tells us that the number of inquirers seeking the kind of information that his survey attempts to supply is greater among workers in subjects not obviously connected with climatology than among meteorologists and climatologists. Their special requirements are many. In agricultural science, soil temperature, the water content of soils, the extent to which the moisture present in the air as invisible vapour falls below the amount required to produce saturation, and the desiccating power of the air, may all be of particular interest. It is important for the inquirer to know whether any or all of these items have been studied, and, if so, where the necessary books of reference are to be found. The anthropologists, with their curiosity about past climates, must follow up a different branch of climatology with a literature of its own.

Prof. Ward is known on the eastern side of the Atlantic for his excellent work on American climates; he may become even better known if he will call in the aid of the official librarians of different countries, and produce the comprehensive survey of which his present paper might well form the nucleus. In an addendum to the paper, the author admits the consciousness that he has done his work with a certain degree of sketchiness—that is a feature of the paper that most meteorologists will undoubtedly notice. But until the thorough cataloguing of the available literature has been done in combination with a judicious weeding out of the unreliable or unsuitable works, few are likely to judge of the extent to which this fault is present.

A recent paper by Dr. C. Braak[2] is an example of meteorological literature of importance outside climatology. The requirements of horticulture have no doubt influenced the course of meteorological study in Holland, and most of the information given in Dr. Braak's paper is of practical importance to nurserymen, who are very much concerned with minimising frost damage, and must take advantage of any available knowledge about the average annual march of temperature both in the air and in the ground, and of the abnormalities of this seasonal march that may be expected to occur in particular years. Dr. Braak's paper is supplementary to an earlier paper by Ch. M. A. Hartman, No. 24 of the same series of publications, in which air temperature alone was considered. Dr. Braak deals, however, with earth as well as air temperature.

In regard to air temperature, the author's discussion is on the customary lines. He does not omit to give statistics in regard to the earliest and latest dates of frost. There is little that calls for criticism in these studies, unless one may be allowed to cavil at a minor point of interpretation of certain statistics in relation to the amount of water vapour in the atmosphere and to the occurrence of night frosts. Dr. Braak found that the average vapour pressure on nights of frost at each of thirteen representative stations was greatest for stations nearest to the coast, and diminished on passing inland. For example, the mean value was 5.6 millibars at Winterswijk and 7.1 millibars at Katwijk, the first named being an inland station, and the last named a coastal one. This is cited as evidence that the distribution of water vapour is of importance in determining the distribution of frost frequency.

Now it is well established that dryness of the atmosphere up to a considerable height favours a rapid fall of temperature at night under a clear sky, but it seems doubtful whether these statistics can be said to prove it. If the interior had sharper frosts than the coast for some other reason, would not the greater fall of temperature ensure a lower vapour pressure as measured near the ground through the greater condensation of hoar frost or fog? It must be remembered that on still and initially clear nights temperature generally falls below the value corresponding with the dew point at sunset and condensation of some kind invariably takes place, provided that the sky remains clear and the wind light. The condensed moisture is partly derived from the air, and the water vapour is thereby reduced.

The section dealing with earth temperature gives far more information on this subject than is to be found in most text books of meteorology. Using the equation

$$a_p = a e^{-p\sqrt{\frac{\pi}{kT}}}$$

where a_p is the amplitude of the periodic variation of period T at a depth p in the ground, and k is the thermal diffusivity given in terms of the depth of soil which can be warmed 1° C. by the heat passing in unit time (here 1 minute) through a layer of soil 1 cm. deep across which a constant difference of 1° C. is maintained, the thermal diffusivity of different soils at De Bilt, Wageningen, and Groningen are examined. The results are compared with similar information given for soils of the same type in Hann's well known "Lehrbuch". The agreement is not close, but the Dutch observations are reasonably consistent among themselves, and the above mentioned divergences may safely be referred to probable differences between the soils in the two sets of observations. The well known effect of aeration of the soil is brought out clearly: for a mixture of sand and peat, k was found to be 0.086 cm. at Groningen, and at the same place for a relatively compact and air free mixture of clay and sand k was 0.482. For peat and sandy clay, Hann gives 0.133 and 0.816 respectively. It is generally recognised that the conductivity of a particular soil is greatly affected not only by the amount of air contained in it but also by its water content and by other factors, which provide additional sources of divergence when closely similar soils are compared at different times.

In conclusion attention may be directed to interesting curves of air and soil temperature in the severe frosts of January-February 1917 and February 1929, on page 55. It is notable how, when the soil is frozen to some depth, the action of the latent heat of fusion of ice during a thaw destroys the normally good general agreement between curves of air temperature and soil temperature at a depth of less than 1 foot, and excellent examples are to be found in these curves. The same applies when freezing is taking place.

[1] *Annals* of the Association of American Geographers, March 1931.

[2] Koninklijk Nederlandsch Meteorologisch Instituut. No. 102. Mededeelingen en Verhandelingen 33. Het Klimaat van Nederland. B (vervolg). Lucht en grondtemperatuur. Door Dr. C. Braak. Pp. 78. (Amsterdam: Seyffardt's Boekhandel, 1930.) 1.00 f.

The National Institute of Industrial Psychology

THE tenth annual Report of the National Institute of Industrial Psychology, as we have already indicated (May 2, p 679), shows steady development of the work of the Institute, despite the prevalent industrial depression Among the industrial investigations undertaken by the Institute in 1930 were time studies of the various operations of machine moulding in aluminium works, which have led not only to considerable savings in time but also to improvements in the working conditions, particularly in ventilation Similar results have attended investigations in a calico dyeing and printing works, whilst studies of packing in a chocolate works led to the design of a new bench which increased output by 10 per cent, and also to the introduction of an improved packing method Other problems examined relate to internal transport in a cotton doubling mill, and the Institute's investigations have been responsible for improvements in the organisation of such varied types of factories as gas works, engineering works a potted meat and fish paste factory, radio works, rubber products factory, spinning mill, wireless and cable offices, oil distribution company During the year, investigations conducted for the railways resulted in valuable recommendations for eliminating accidents in goods shunting and for reducing pilfering and damage to goods

A feature of the industrial investigations of the Institute during 1930 is, however, the extent to which it has been called upon to apply its experience and methods of vocational selection to the solution of problems concerning personnel Contributions of this kind have been made in the recruitment of staff for chemical works, cleaning works the selection of telephone operators for the G P O, as well as in the selection of general staff for insurance offices and retail stores It is thus evident that the value of the research in the field of vocational guidance already carried out by the Institute is now widely recognised, and the account of the Institute's Carnegie experiment, to be published under the title of Methods of Choosing a Career ", should be assured of a wide reading

Research work is being carried out in this field in association with the Juvenile Employment Department of the Birmingham Education Committee to determine the applicability of the Institute's methods in the Borstal institutions The Fife Carnegie experiment in vocational guidance has continued in co-operation with the Medical Department of the Fife Education Authority and with the Juvenile Advisory Committee of the Employment Exchange, whilst other members of the research staff are attempting to follow up private vocational guidance cases and to prepare occupational analyses for the use of the vocational guidance section Some of the research on industrial psychology in progress at the Universities of Cambridge, London, Leeds, Durham (Armstrong College), Edinburgh, Glasgow, Aberdeen, and St Andrews is itself definitely related to vocational guidance or selection Examples are the studies of vocational guidance in the Cambridge area carried out by Mrs Ramsay, of employment psychology at Durham, educational psychology at Leeds, on perseverance and character at King's College, London, and on the testing of printers' apprentices at Edinburgh

The Institute of Industrial Psychology is itself responsible for research on the nature and measurement of the mental abilities involved in various types of factory assembly operations, on colour discrimination, on daily fluctuations in industrial efficiency, and on occupational prospects for boys, based on a representative group of 500 working boys, employed and unemployed An investigation conducted by Dr Pinard elaborated tests for perseveration which have facilitated a division of people into three and not into two classes as required by Jung's theory, and are now being applied for the selection of good leaders A research on methods of diagnosing social ability, especially the capacity to 'handle' people has been commenced, and investigations which have led to the elaboration of standardised tests for motor drivers have attracted a considerable amount of interest

Not the least important feature of the Institute's work is that which it has carried out on behalf of the National Institute for the Blind (more particularly during the past year), its studies of the organisation, working methods, and conditions of various blind workshops The interest of this work lies not so much in its remarkable effect in increasing efficiency in such workshops, but in the extent to which it assists the blind to become useful and effective members of the community and breaks down the isolation so characteristic of the blind worker

The Microscope and the Paint Industry

THE value of the microscope in the study of pigments is being increasingly realised by the British paint industry, also in Germany and elsewhere It has long been known that chemical analysis alone was quite insufficient for evaluating the true properties of a pigment, but that particle size and shape are, among other things, of very great importance, especially in determining the nature and extent of the reaction, for example, between the pigment and an oil medium like linseed oil

In a recent article in the *Farben Zeitung* (Mar 7, 1931), Dr A V Blom describes the results of an examination of red lead by a polariscope with crossed nicols One of his principal findings was that the reactivity of the red lead with linseed oil depended not only on the size of the particles but also on their shape, and that even particles of the same form varied in this respect He distinguished at least six different forms and conditions of particle, of which the first is smooth and crystalline, and not readily affected by linseed oil, the second is small and spherical, and the others are more or less oxidised varieties of the first or second The most recent research in crystal growth has shown that atoms are most active at their edges and corners, also that crystals are made up of blocks or sections separated from one another by submicroscopic channels Surface energy is not, therefore, uniformly distributed in a crystal, but varies with its molecular density, and the critical energy increment of the surface reaction may vary considerably in one and the same crystal In the case of red lead, linseed oil only enters into reaction where it is in direct contact with the lead oxide surface, forming lead soap or linoleate These soap molecules also occur in many different forms, including the colloidal, in which case they would not be seen between crossed nicols

It was found that a 100 per cent red lead from which all free lead oxide had been removed by careful and repeated extraction with ammonium acetate solution was changed quantitatively in the course of two years into non isotropic spherical crystals if it was in contact with pure linoleic acid In commercial red leads, all these various forms of particles are found in widely differing proportions, causing correspondingly wide differences in the qualities of the red lead

University and Educational Intelligence.

CAMBRIDGE.—The General Board has appointed Dr. H. Jeffreys, of St. John's College, reader in geophysics.

The Council of the Senate has recommended that it be authorised to inform the Plummer Trustees that the University would approve of the establishment in the University, on the John Humphrey Plummer Foundation, of professorships of inorganic chemistry, of mathematical physics, and of colloid science, and of an annual payment at the initial rate of £300 from the Plummer Fund towards the maintenance of the Department of Colloid Science.

The Council of the Senate has issued a report on the proposed allocation of the Rockefeller benefaction. In 1928, the International Education Board offered to provide a sum not exceeding £700,000, provided that the University obtained from other sources the balance of £479,000 necessary to put the scheme into operation. At his installation last year, the Chancellor announced that the University had received promises which would enable it to satisfy this condition. The complete scheme consists of two parts, one dealing with the University Library involving a capital sum of £500,000, and the other dealing with scientific developments involving a capital sum of £679,000.

On the scientific side of the Rockefeller scheme, money is to be received from the International Education Board *pro rata* as it has been collected and paid in from outside sources or guaranteed by the University. At present, the University has received approximately £110,000 from outside sources and £210,000 from the International Education Board. The income of the sums already in hand will be about £15,000. In the opinion of the Council of the Senate, this income is sufficient to finance those parts of the Rockefeller scheme which the heads of departments think can now suitably be put in hand, provided that the professorship of mathematical physics and a professorship of colloid science (to replace the temporary professorship of colloidal physics) are financed from the Plummer Foundation. The Council has accordingly recommended that the General Board be requested to take the necessary steps to bring into operation, by Oct. 1, 1931, so much of the scheme as can be carried out under present conditions.

EDINBURGH.—The University Court, at its meeting on April 27, resolved to appoint as the first professor of geography, Mr. Alan G. Ogilvie, at present reader in geography at the University, the appointment to begin from Oct. 1, 1931. The foundation of this new chair has been made possible by a grant from the Carnegie Trustees and funds collected by public subscription through the action of the Royal Scottish Geographical Society.

LONDON.—Prof. Max Jakob is giving a course of four lectures on "Steam Research in Europe and in America", at the Institution of Civil Engineers, on May 7, 8, 14, and 15 at 5.30 P.M. The lecture on May 14 will deal with optical measurements—theories and thermodynamical evaluation and control of the results of experimental work, and that on May 15 with special thermal properties and processes of water and steam, and a note on international steam table conferences and international steam tables. Admission to these lectures is free, without ticket.

OXFORD.—The debate on the enlargement and improvement of library facilities in Oxford has been postponed to May 19; the voting on the actual decree to take place on May 26. In each of the schemes now before Congregation, the addition is advocated of a new wing to the Radcliffe Science Library.

The Rhodes Memorial lectures will be delivered in German, on May 9, 16, and 23, by Prof. A. Einstein, on "The Theory of Relativity".

APPLICATIONS for a Ramsay Memorial Fellowship for Chemical Research will be considered at the end of June next. The fellowship will be of the annual value of £250, with a possible additional sum of not more than £50 per annum for expenses. The tenure of the fellowship will be two years, but it may be extended for a third year. Applications should be sent not later than June 5 to the Secretary, Ramsay Memorial Fellowships Trust, University College, Gower Street, W.C.1.

UNIVERSITY COLLEGE, London, in its recently published report for the year ending February 1931, records the closing, as from July 31, 1930, of the College Centenary Appeal Fund, which was inaugurated in 1925. The appeal was for £500,000 and towards this a sum of £227,764 was raised. Among the departments for the development of which contributions from the fund have been made are those of chemical engineering and zoology. To the former has been allocated more than £60,000, the full amount appealed for in 1925; but meanwhile the position and needs of the department have been reviewed by a special committee over which the late Lord Melchett presided and a further sum of £110,000 will be needed to give effect to this committee's scheme. For the department of zoology, the appeal asked for £50,000, but the International Education Board interested itself in the matter and offered to pay half the cost of a wider scheme involving an expenditure of £240,000. The question of ways and means for qualifying for this gift is now engaging the attention of the College Committee. The total number of students registered last session is 3150, as against 3249 the preceding year. The decrease is more than accounted for by the fact that there was in 1929 no vacation course in spoken English for foreign students, the attendance at which normally exceeds two hundred.

Birthdays and Research Centres.

May 9.—SIR JAMES IRVINE, F.R.S., Principal and Vice-Chancellor of the University of St. Andrews.

In large measure through the adoption of methods developed in my earlier researches on sugars, the structural chemistry of carbohydrates has been greatly expanded during the past thirty years. The progress is gratifying, yet, after all, it must be admitted that these advances, which enable us to ascribe structural formulæ to representative carbohydrates, do not lead very far towards the interpretation of fundamental problems.

So many questions remain unanswered. Is glucose the first product of photosynthesis? Why are sugars optically active, and why is the glucose configuration favoured above all others? By what processes are the hexoses converted one into the other? What is sucrose and how is it formed? These are but examples. If I had my scientific life to live over again, I would study these additional problems, but would do so under conditions approximating to those which prevail in plant and animal life. If it be the case that "even a paramecium is not quite himself under the fierce light which beats on the microscope stage", it is equally true that a sugar is unlikely to reveal its true characteristics when exposed to the fierce reagents of the organic chemist.

Societies and Academies

LONDON

Royal Society, April 30 —**A E H Tutton** Determination of the yard in wave lengths of light The author has carried out a determination of the number of wave lengths of the red light radiations of hydrogen (H_α) and cadmium (Cd_r), and of the yellow radiations of neon (Ne_c), in the British Imperial Standard Yard, by an original method The Imperial Standard Yard, at the official temperature 62° Fahrenheit and 760 mm barometric pressure, is found to comprise 1,420,210 3 wave lengths of the standard red lines of cadmium, Cd_r, 1,562,408 6 wave lengths of the yellow neon line Ne_c and 1,393,266 5 wave lengths of the red hydrogen line H_α Instead of relying on direct determinations with cadmium light, to produce which the vacuum tube has to be heated to 340° C which was found gravely to affect the thermal equilibrium and thereby the accuracy of the observations, the direct determinations with H_α (which is very close to Cd_r) and Ne_c were used to calculate the value for Cd_r, the two independent values thus obtained for Cd_r were 1,420,210 8 and 1 420,209 8, an agreement which gives every confidence that the round number 1,420,210 is very near the truth It is suggested that this round number might be taken as the length of the British yard —**U R Evans, L C Bannister, and S C Britton** The velocity of corrosion from the electrochemical standpoint By excluding oxygen from the anodic areas, it has been found possible to tap and measure the whole of the electric current responsible for the corrosion of iron, and to show that the whole attack is of an electrochemical character The current can never exceed that limiting value which would cause so much polarisation as to make the cathodic and anodic potentials equal, such 'equipotential' conditions are closely approached at high salt concentrations Most of the polarisation occurs at the cathodic area The law governing the ratio of anodic and cathodic areas is that the anodic area extends until the cathodic current density reaches the 'protective value' requisite to prevent further extension —**T L Eckersley** On the connexion between the ray theory of electric waves and dynamics There is a very close analogy between the analytical description of the transmission of such electromagnetic waves and Schrödinger's wave theory of quantum dynamics Optical ray methods are often used in the analysis of wireless wave transmission and the rays can be given a dynamical interpretation as the orbits of a group of waves (considered as a particle) The approximate ray method of analysis bears the same relationship to the true wave method that the Newtonian dynamics bears to the new wave mechanics The theory can be applied to the transmission of waves between the earth and Heaviside layer and approximate solutions obtained which, in the particular case of a well defined conducting layer give G N Watson's value of the attenuation coefficient The solutions, like the older Bohr Sommerfeld quantum solution, are incomplete, giving the direction cosines and attenuation coefficients, but not the amplitudes The method, however, can be applied to a wide variety of cases —**Lord Rayleigh** On a night sky of exceptional brightness, and on the distinction between the polar aurora and the night sky An exceptionally bright night sky on Nov 8, 1929, is described, with photometric observations It was of about four times the ordinary brightness and eight times the minimum ever observed It was of the same chromatic constitution as usual, and the aurora line was not conspicuous There was no accompanying magnetic disturbance Spectra of the aurora and of the normal night sky are reproduced for comparison Nitrogen bands are absent in the latter Two unidentified bright lines in the night sky spectrum are remeasured The wave lengths found are 4419 and 4168 —**T H Havelock** The wave resistance of a spheroid It is shown how to calculate the wave resistance of an ellipsoid submerged in water and moving horizontally in any orientation Explicit results are given for prolate and oblate spheroids moving in the direction of the axis of symmetry and at right angles to that axis —**O W Richardson and P M Davidson** The spectrum of H_2 The bands ending in $2p\,^3\Pi$ levels The bands of the H_2 spectrum are described which start on the levels $3d\,^3\Sigma$, $3d\,^3\Pi_{ab}$, $3d\,^3\Delta_{ab}$, $4d\,^3\Sigma$, $4d\,^3\Pi_{ab}$, $4d\,^3\Delta_{ba}$ and end in $2p\,^3\Pi_{ab}$ The upper levels show pronounced uncoupling phenomena, and their properties are otherwise similar to those of the corresponding singlet levels of H_2 and also to those of the $d\,^3\Sigma$, $d\,^3\Pi$, and $d\,^3\Delta$ levels of He_2 The $3d\,^3\Sigma \rightarrow 2p\,^3\Pi$ bands show a strong Zeeman response, just as do the $3d\,^1\Sigma \rightarrow 2p\pi\,^1\Sigma$ bands The constants of the final Π levels, common to all the bands, are in good agreement with the supposition that this is the continuation at $n = 2$ of the upper levels of the α, p, λ bands for which $n - 3$, 4, and 5 —**C M M Dowell and F L Usher** Viscosity and rigidity in suspensions of fine particles (1, 2) In lyophobic suspensions of charged particles in an aqueous liquid, variation of viscosity with rate of shear is dependent on the formation of aggregates, whilst rigidity depends on the linking of the aggregates to form a continuous structure Measurements of rigidity and of viscosity in relation to rate of shear were also made in suspensions of uncharged particles in inert organic liquids of the same density as the solid, in conjunction with microscopic observations Photomicrographs show the existence of aggregates and structures or their absence, accordingly as the suspensions exhibit or fail to exhibit variable viscosity and rigidity

(*To be continued*)

PARIS

Academy of Sciences, Mar 23 —**Elie and Henri Cartan** The transformations of closed domains enclosing the origin —**Paul Vuillemin** The mode of action of malaria therapy A discussion of the use of organisms causing fever in the treatment of syphilis and its sequels —**J Favard** The zeros of polynomials —**V Romanovsky** Generalisations of a theorem of E Slutsky - **G Vranceanu** Some theorems relative to non polynomial varieties and systems of forms of Pfaff - **Chevalley and Herbrand** Topological groups, Fuchsian forms, free groups —**Otton Nikodym** Suites of perfectly additive functions of abstract ensembles —**Tesar** The representation, in magnitude and in direction, of internal forces in the case of problems of plane elasticity —**P Dupin and E Crausse** The vibration of cylindrical tubes in water under the influence of alternating vortices -**L Goldstein** The quantic mechanics of collisions of the second kind —**G Dupouy** Electrical measuring apparatus with moving coil in a uniform field The usual construction makes the deviations of the coil proportional to the current to be measured In certain cases, however, it is advantageous to design the magnetic field in such a manner as to increase the sensitivity at one point, the graduations are unequal, but over a certain portion of the scale the readings are very open Such an arrangement is useful for relays Other possible applications are suggested —**J Fridrichson** The resonance spectrum of sulphur vapour —**J Barbaudy, A Guérillot, and R Simon** A continuous recorder for the pH of nickel plating baths An application of the Leeds and Northrup recording potentiometer —**René Dubrisay and R François** The solubility of

calcium carbonate in water in the presence of alkaline chlorides The alkalinity of water in contact with calcium carbonate is increased by the addition of potassium chloride to the aqueous solution, and the alkalinity produced increases with the concentration of the potassium chloride With the higher alkalinity increasing amounts of calcium pass into solution —**P Laffitte** and **M Patry** The velocity of the phenomena caused by the detonation of solid explosives —**E Carrière** and **Raulet** Contribution to the study of the sodium silver hyposulphite complexes Three compounds have been isolated and analysed, $NaAgS_2O_3$, $Na_4Ag_2(S_2O_3)_3$, and $Na_3Ag(S_2O_3)_2$, of which the first two have been previously described **F Salmon-Legagneur** α Carboxycamphocean β acrylic and β propionic acids —**F Zambonini** and **V Caglioti** New researches on the chemical composition of romanechite —**Mlle Eliane Basse** The structure of the massif of Mikoboka and of the plateau of Analavelona, south west of Madagascar —**Raymond Ciry** The presence of a facies with cephalopods in the Coniacian of the north east of the province of Burgos (Spain) —**Jean Marçais** Observations on the geology of the region of Tizi Ouzli (Eastern Rif) —**Mihaïlovitch Jelenko** The great seismic catastrophe of Mar 8, 1931, in southern Jugo Slavia —**A Eichhorn** and **R Franquet** The somatic karyokinesis of *Bolbostemma paniculatum* —**Maurice Hocquette** and **L Arsigny** Secretion by the stem meristem of *Cuscuta epithymum* of substances injurious for the tissues of the hosts —**Alb J J Van de Velde, A Verbelen,** and **L Dekoker** Biochemical researches on arable soil —**Acolat** Anatomical researches relating to the separation of venous blood and arterial blood in the frog's heart —**Charles Pérez** The roots of the parasitic rhizocephalic parasites of the hermit crab —**Radu Codreanu** The evolution of the *Endoblastidium*, a new genus of cœlomic parasite of the larvæ of *Ephemera* —**G Delamare** and **C Gatti** The spirochætes of an encysted pleurisy, offensive and temporarily gangrenous

CRACOW

Polish Academy of Science and Letters, Dec 1 —**Cz Bialobrzeski** Four ways of looking at the mechanism of the radiation of a star To the three modes of considering the radiation of a star mentioned in previous communications the author adds a fourth The movement of the photons of which the radiation is composed can be treated like the Brownian motion The mean time necessary for the photon to travel a distance equal to the radius of the star is calculated and the radiation of two stars is compared by means of the formulæ obtained —**St Mrozowski** The hyperfine structure of the 2537 A resonance line of mercury —**Mlle Z Debinska** The crystalline structure of cathode deposits Gold and platinum deposited at temperatures of −80° C to −180° C show no crystal line structure at definite higher temperatures a crystalline structure develops —**K Dziewonski** and **J Schnayder** Studies in the fluorene series (2) Syntheses of ketones 2 acetofluorene and 2, 7 diacetofluorene —**S Maziarski** The muscular tissue of insects (3) The periovarian muscular networks (myosyndesmium) in the Coleoptera —**K Sembrat** Cytological researches on the plasma components and, in particular, on the Golgi apparatus and the vacuome during the gametogenesis of the Triclades, *Dendrocœlum lacteum* and *Planaria gonocephala* —**F Bieda** The Nummulina fauna found in the pebbles of the conglomerates of the Polish Carpathians —**J Jodlowski** The histological structure of the fibre glands of the larvæ of ants —**R J Wojtusiak** New observations on the faculty possessed by the larvæ of *Pieris brassicæ* of finding their way about

Official Publications Received.

BRITISH.

The Science Masters Association Report for 1930 with List of Members (correct to February 1931), Statements of Accounts and Report of Business Meeting Pp 80 (Harrow Harrow School Book Shop)

Proceedings of the Royal Society Series A, Vol 131, No A816, April 2 Pp 274 (London Harrison and Sons, Ltd) 14s

Quarterly Journal of the Royal Meteorological Society Vol 57 No 239 April Pp 117 242 (London Edward Stanford Ltd) 7s 6d

The Institution of Professional Civil Servants Annual Report of Council for the Year 1930 Pp xiii+58 (London)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 69 No 412 April Pp 445 556+xxx (London E and F N Spon Ltd) 10s 6d

Education for the Engineering Industry 1 Report of the Committee on Education for the Engineering Industry 2 Comments on the Report by Educational Bodies Pp vii+67 (London H M Stationery Office.) 1s 3d net

Proceedings of the Society for Psychical Research Part 118, Vol 39, April Pp 375 418 (London) 3s

Reports of the Great Barrier Reef Committee Vol 3 Pp v+72+10 plates (Brisbane Frederick Phillips)

The Marine Biological Station at Port Erin being the Forty fourth Annual Report of the former Liverpool Marine Biology Committee, now the Oceanography Department of the University of Liverpool Drawn up by Prof Jas Johnstone Pp 36 (Liverpool University Press of Liverpool) 1s 6d net

FOREIGN

U S Department of Agriculture Technical Bulletin 221 Wild Duck Foods of North Dakota Lakes By Franklin P Metcalf Pp. 72 (Washington D C Government Printing Office) 15 cents

University of Illinois Engineering Experiment Station Bulletin No 221 An Investigation of Core Oils By Carl H Casberg and Carl E Schubert Pp 19 15 cents Bulletin No 222 Flow of Liquids in Pipes of Circular and Annular Cross Sections By Prof Alonzo P Kratz, Prof Horace J Macintire and Richard E Gould Pp 26. 15 cents Bulletin No 223 Investigation of various Factors affecting the Heating of Rooms with direct Steam Radiators Conducted by the Engineering Experiment Station, University of Illinois, in cooperation with the Institute of Boiler and Radiator Manufacturers and the Illinois Master Plumbers Association By Prof Arthur C Willard, Prof Alonzo P Kratz Maurice K Fahnestock and Seichi Konzo Pp 102 55 cents Bulletin No 224 The Effect of Smelter Atmospheres on the Quality of Enamels for Sheet Steels A Report of an Investigation conducted by the Engineering Experiment Station University of Illinois, in coöperation with the Utilities Research Commission By Prof Andrew I Andrews and Emanuel A Hertzell Pp. 15 10 cents Bulletin No 225 The Microstructure of some Porcelain Glazes By Clyde L. Thompson Pp 21 15 cents (Urbana, Ill)

CATALOGUE.

Zenith Resistances and Rheostats Pp 35+15 (London The Zenith Electric Co Ltd)

Diary of Societies

FRIDAY MAY 8

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall Morecambe) at 11 A M —P W Ladmore Recent Municipal Works in Morecambe and Heysham

ROYAL ASTRONOMICAL SOCIETY at 5 —Prof W de Sitter Jupiter's Satellites (George Darwin Lecture)

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Human Monsters and Malformations (3) Tumour like Formations which appear to represent the Inclusion of one Twin within the Body of Another

ROYAL SOCIETY OF MEDICINE (Clinical Section) at 5 30 —Annual General Meeting

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5 30 —Prof D Tovey Paper with Musical Illustrations

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6 —Dr S Stillman Berry A Redescription of *Lepidopleurus clathrata* (Reeve) —C Diver A Method of Determining the Number of the Whorls of a Shell and its Application to *Cepæa* —J H Fraser On the Size of *Urosalpinx cinerea* (Say) with some Observations on Weight-Length Relationship —Exhibit British *Vertigo* and *Urosalpinx* and *Ocenebra*.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —M G Holmes and L F Salter The Development of the London Automatic Telephone System

RAILWAY CLUB (at 57 Fetter Lane), at 7 30 —C R G Stuart Great Southern Railways, Ireland

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Dr G W C Kaye The Measurement of Noise

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Forrester's Hall Dundee) —Prof W Cramp The Birth of Electrical Engineering (Faraday Lecture).

INSTITUTION OF STRUCTURAL ENGINEERS (at South Wales Institute of Engineers Cardiff) (Annual General Meeting) —F E Drury The Structural Engineer and his Vocational Training

MONDAY, MAY 11

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4 30 —Major W Elliot The Work of the Empire Marketing Board

ROYAL GEOGRAPHICAL SOCIETY, at 5 —Dr S W Wooldridge and D J

Smetham The Glacial Drifts of Essex and Hertfordshire and their Bearing upon the Agricultural and Historical Geography of the Region

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Sir Arthur Keith Human Monsters and Malformations (4) Parasitic Fœtuses of Various Kinds Their Origin and Nature

IRON AND STEEL INSTITUTE (at Cleveland Technical Institute, Middlesbrough), at 7 30—O Cromberg Production Economy in Iron and Steel Works—A Robinson The Melting Shop of the Appleby Iron Company Limited

CHARTERED SURVEYORS INSTITUTION at 8—S A Smith Valuations of the Assets of Public Companies

MEDICAL SOCIETY OF LONDON—Sir John Rose Bradford, Bart Annual Oration

TUESDAY, MAY 12

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at Royal Automobile Club) at 5 30—Dr G H Miles Practical Tests for Drivers (Lecture in Connexion with National Safety Week).

ZOOLOGICAL SOCIETY OF LONDON, at 5 30—Prof Syuti T Issiki On the Morphology and Systematics of Micropterygidæ (Lepidoptera Homoneura) of Japan and Formosa with Considerations on the Australian, European and North American Forms.—W Fernando The Development of the Kidney in *Ampullaria (Pila) gigas* (Gastropoda).—E Banks The Forms of Prevost's Squirrel found in Sarawak—Dr R. Broom (a) On the Skull of the Primitive Reptile *Areoscelis* (b) On the Vomerine Bones in Birds

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts) at 5 30.

INSTITUTION OF CIVIL ENGINEERS at 6—Annual General Meeting

INSTITUTE OF MARINE ENGINEERS at 6—O E Jorgensen Low Cost Motorships

QUEKETT MICROSCOPICAL CLUB (at Medical Society of London) at 7 30—A E Clarence Smith Some Observations on Diatom Resolution and Structure

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8 30—Annual General Meeting

WEDNESDAY, MAY 13

ROYAL SOCIETY OF MEDICINE (Surgery—Sub Section of Proctology) (Annual General Meeting), at 5—Discussion on The Injection Treatment of Piles

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5—Sir Arthur Keith Human Monsters and Malformations (5) Malformations due to Irregular Implantation of the Ovum and to the Formation of Amniotic Adhesions

INSTITUTE OF FUEL (at Burlington House), at 6—Dr A Thau Continuous Production of Water Gas from Powdered Fuel

TELEVISION SOCIETY (at University College), at 7—H Wolfson The Development of Cuprous Oxide Photo Electric Cells (Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub Centre) (at Portsmouth Municipal College), at 7 30

ROYAL SOCIETY OF ARTS at 8—Major R A B Smith Architecture in Concrete on the Pacific Coast

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8 15—N R. Laban Problems in Chromium Plating and High Current Density Nickel Plating

THURSDAY, MAY 14

ROYAL SOCIETY at 4 30—Prof H Geiger, Lord Rutherford, and others Discussion on Ultra penetrating Rays.

LINNEAN SOCIETY OF LONDON at 5—Miss R F Shove Dwarf Elm Tree (1900-1931)—A J Wilmott A Botanical Tour in Spain—C F A Pantin The Physiology of Variation

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5—Prof J E Lennard Jones Quantum Mechanics of Atoms and Molecules (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6—Commemoration of Centenary of the Birth of David Edward Hughes Short Discourse on the Life and Work of Hughes by S Evershed—At 6 45—Annual General Meeting

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30—C Fritsche The Metal clad Airship

IRON AND STEEL INSTITUTE (at Chamber of Commerce, Birmingham), at 7—First Report on the Corrosion of Iron and Steel Being a Report by a Joint Committee of the Iron and Steel Institute and the National Federation of Iron and Steel Manufacturers to the Iron and Steel Industrial Research Council—O Cromberg Production Economy in Iron and Steel Works—H J Gough and A J Murphy On the Nature of Defective Laminations in Wrought-Iron Bars and Chain Links—A Robinson The Melting Shop of the Appleby Iron Company, Limited

OIL AND COLOUR CHEMISTS ASSOCIATION (Annual General Meeting) (at 30 Russell Square) at 7 30—W D Owen and A M Thomas Properties of Synthetic Resins

OPTICAL SOCIETY (Annual General Meeting) (at Imperial College of Science), at 7 30—At 8—Prof G P Thomson Electron Diffraction Phenomena (Lecture)

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8 30—Annual General Meeting

BRITISH INSTITUTE OF RADIOLOGY (Annual General Meeting), at 8 30—Dr H S. Souttar The Ideal Distribution of Radon Seeds

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ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4—Sir Arthur Keith Human Monsters and Malformations (6) A Consideration of the Commoner Malformations to ascertain how far they can be explained by regarding them as Atavistic States or as due to Parental Influences.

ROYAL SOCIETY OF ARTS (Indian Section), at 4 30—F S Grimston The Indian Ordnance Factories and their Influence on Industry

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5.

PHYSICAL SOCIETY (at Science Museum, South Kensington), at 5 15—Sir Richard T Glazebrook Standards of Measurement their History and Development (Guthrie Lecture).

INSTITUTE OF CHEMISTRY (Belfast and District Section) (at Royal Belfast Academical Institution), at 7 30.—Annual General Meeting

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section) (Annual General Meeting), at 8.—The Relative Value of the Induction of Premature Labour, Test Labour, and Cæsarean Section in the Treatment of Minor Degrees of Contracted Pelvis.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9—Prof J C Philip Experimental Aspects of Hydrogen Ion Concentration

SATURDAY, MAY 16

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LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5—Sir George Newman The Rise of Preventive Medicine (Heath Clark Lectures) (5)

MONDAY, MAY 11

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5—Dr C F White Port Work

TUESDAY, MAY 12

LONDON SCHOOL OF ECONOMICS, at 5—Prof L. Hogben Some Aspects of Human Inheritance (8) Mental Inheritance

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital W 2), at 5—Prof C A Ariens Kappers The Function of the Various Layers of the Cortex

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LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division) at 5—Dr B Hart Mental Hygiene

ST THOMAS'S HOSPITAL, at 5 30—Prof G Grey Turner Resection of the Rectum (Succeeding Lecture on May 15)

THURSDAY, MAY 14

GUY'S HOSPITAL MEDICAL SCHOOL at 5—Prof W R Sorley Science and Morals (Fison Memorial Lecture).

NATIONAL HOSPITAL FOR DISEASES OF THE HEART, at 5—Sir Thomas Lewis Ischæmia of Muscle as a Cause of Anginal Pain (St Cyres Lecture).

FRIDAY, MAY 15

LONDON SCHOOL OF ECONOMICS at 5—Lord Lugard of Abinger British Rule in Tropical Africa (Succeeding Lectures on May 18 and 19)

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5—Prof E L Collis Industrial Hygiene Respiratory Diseases

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5 30—Dr H de Bockh Selected Chapters of Regional Geology and Tectonics (Succeeding Lectures on May 19 and 21)

KING'S COLLEGE LONDON at 5 30—Col the Master of Sempill Air Communications of the British Empire

INSTITUTION OF MECHANICAL ENGINEERS, at 8—Prof E L Collis The Coal Miner His Health and Occupational Diseases (1) Environment of Work (Chadwick Lecture)

ANNUAL MEETING

MAY 7 AND 8

IRON AND STEEL INSTITUTE (at Institution of Civil Engineers) at 10 A M

Friday May 8, at 10 A M—General Meeting

Announcement of the award of the Andrew Carnegie Research Scholarships for 1931-32

Announcement of the award of the Carnegie Gold Medal to Dr E Valenta.

Announcement of the award of the Williams Prize to F Bainbridge

Dr W Rosenhain and A J Murphy Accelerated Cracking of Mild Steel (Boiler Plate) under Repeated Bending

H J Gough and A J Murphy On the Nature of Defective Laminations in Wrought-Iron Bars and Chain Links

A L Norbury and E Morgan The Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron

At 2 30—V Harbord The Basic Process Some Considerations of its Possibilities in England

E C Evans L Reeve, and M A. Vernon Blast-Furnace Data and their Correlation—Part II

C O Bannister and W D Jones The Sub-Crystalline Structure of Ferrite

C H M Jenkins and H J Tapsell Some Alloys for Use at High Temperatures Complex Iron Nickel Chromium Alloys. Part III—The Effect of Composition and Exposure to High Temperatures

Papers to be presented and discussed by correspondence—

Sir H C H Carpenter and J M Robertson The Formation of Ferrite from Austenite.

J H Chesters and W J Rees Refractory Materials for the Induction Furnace.

Dr J Newton Friend and W West The Resistance of Copper Nickel Steels to Sea Action.

E Ohman X Ray Investigations on the Crystal Structure of Hardened Steel

G Phragmén: X Ray Investigation of Certain Nickel Steels of Low Thermal Expansion.

SATURDAY, MAY 16, 1931.

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Forestry Research in Great Britain

IN days gone by, research work in connexion with forestry was regarded by the average forest officer, whether administrative or executive in grade, as of little practical value , only by the few was the idea even held that such work might have an academic value That this was the accepted point of view throughout the greater part of last century can be readily ascertained by studying the work of the various forestry departments in European countries Outside Europe, India and Japan may be instanced as examples where the same ideas prevailed amongst senior forest officers

The dawn of the twentieth century witnessed the beginnings of a change of opinion in some of the more efficiently managed forest departments in Europe The awakening came slowly, and cannot be attributed to any one set of factors Greater demands for timber and other forest products, more intensive working of the forests, the larger areas of artificially formed forests, and the introduction and increase in areas of plantations of exotics, especially coniferous species - all of these may be said to have aroused interest in, and shown the necessity for, research work The recognition resulted in the establishment of research centres or departments in several European countries, either in connexion with universities where forestry schools were in existence or in strengthening the pure science branches of the existing forest schools

It was, however, one of the outcomes of the War which may be said to have given the greatest impetus to forest research work in Europe, as was the case in India, though the chief causes in the two instances were to some extent dissimilar The greatly increased costs in connexion with forest work of all kinds necessitated a reduction, or elimination, where possible, of all waste According to locality factors, climate, species dealt with, and so forth, a set of problems were presented to the forest administration which demanded a solution, the underlying financial idea being the production of forest crops yielding a larger volume of material on a smaller area or in a shorter space of time than had been the case in the past, or on poor quality land not under forests

These types of problems have a varying importance for the research officer, depending upon the nature of the forest in question, whether indigenous or not The matter becomes of the first importance, however, when (1) exotics, especially conifers in Europe, are being employed on a large scale to reafforest areas formerly occupied by indigenous

forest, (2) where bare lands, which have been for long unforested, and may or may not have carried forest before, are being planted on a wholesale scale, whether with indigenous or exotic species—the latter usually with the expressed or implied wish or hope that a larger volume of material will be produced per unit of area in a shorter space of time than is the case with an indigenous species

The officers responsible for the introduction of the policy implied under (1) and (2) are the administrative forest officers, the executive officers carrying it out Until comparatively recently, the research officer, if he existed, has had no voice in formulating an afforestation or reafforestation policy, nor was he often consulted with reference to the species to be made use of in afforesting bare lands, or in the choice between indigenous or exotic species The part of the research officer came into play when disease had made its appearance in the plantations formed under a preordained policy

Of late this position has been reversed in some of the countries of Europe Sweden may be quoted as an illustration, since it is common knowledge that the Swedish forests play a most important part in the economy of the nation, forest produce taking a high place in that country's export trade Apart from the ordinary work in regenerating the areas annually felled, Sweden has undertaken an extensive afforestation campaign on barren lands, of which large areas are of a varying type of peat As Dr Rayner has shown in her letter in NATURE of April 4, a close collaboration exists in Sweden between the pure science workers and forestry specialists at the research centres and the Swedish Forest Service To quote Dr Rayner's example ' the significance ', she points out "of mycorrhiza in nutrition, and the urgent need for laboratory research directed to promote control of its formation in new plantations, have long been matters of concern in the Swedish Forestry Service, and are becoming so in those of other countries, for example, in certain of the North American States In Great Britain and many parts of the Empire the matter is one of special interest and concern in view of the extensive afforestation of non woodland soils and the use of exotic tree species "

That research work would be necessary in connexion with an afforestation programme in Great Britain was realised by the framers of the 1919 Forestry Act, for under the powers given to the Forestry Commissioners was a clause "to conduct and assist research" In the interests of true research work (apart from its purely forestry aspects) it might have been better had the words ' to conduct ' been omitted from the above clause, and so have left research without the fetters of Government control more especially in the case of a new department with all to learn

In their Annual Report for the year ending Sept 30, 1925, in connexion with research and experiments, the Commissioners wrote "The work embraces the establishment and periodic measurement of permanent sample plots of growing timber, from which valuable data on the rate of growth and methods of thinning are being obtained, extensive nursery and plantation experiments directed towards the improvement of afforestation technique, entomological and mycological work on the protection of nursery stock and trees from insects and fungi, as well as botanical, physiological, and chemical work on subjects such as the establishment of trees in peaty soils" This work, it was said, was carried out by the Commission's experiment officers, "while allied laboratory work is conducted at the educational institutions which are in receipt of grants from the Commissioners"

It may be at once admitted that some valuable work of a purely professional nature—the maintenance of sample plots, the preparation of yield tables for several species, investigations into the importance of the origin of seed, preliminary work on the treatment of peaty soils, the issue of leaflets on certain common diseases, and so forth—has been accomplished during the first decade of the Forestry Commissioners' work They have also co operated with the Forest Products Research Board When, however, the question of pure research work and its value and importance to the future of forestry in Great Britain are considered, it cannot be said that the Commissioners have approached the matter from an unbiased point of view

The Commissioners commenced their work with the underlying idea that they were to be the sole arbiters on everything connected with forestry in Great Britain Up to a certain point this may have been sound In the case of true research the contrary was the case The research work to be carried out and the lines upon which it was to proceed were laid down by the Commissioners, and yet it is certain that they would be the first to admit that they laid no claim to be considered, as a body, men of scientific attainments Choice of work to be carried out, choice of centres at which certain parts were to be undertaken, all were laid down in the absence of a knowledge of the broader and vital aspects of the work envisaged—aspects the

importance of which, as is so well indicated by Dr Rayner's letter, can only be foreshadowed by the research worker Perhaps as fatal to progress of real value was the policy, so common to Government departments in the past, of concentrating the work desired either in a cadre of inevitably more or less inexperienced 'experiment officers' of their own, or of confining part of the work to centres selected on some narrow system of choice and without a definite knowledge of the work being carried out at other institutions in the country, perhaps already better equipped than the ones chosen and accorded grants

The next decade of the work of the Forestry Commissioners will be a momentous one The money to be spent in pure afforestation work on new lands runs to a considerable figure In this one instance it is becoming obvious that soil research work will perhaps be the deciding factor between success and failure The Commissioners will be well advised if they mobilise for this work every centre in the country—and they are but too few—capable of assisting in this vital matter A few more or less isolated investigations into peat areas barely touches upon the fringe of the soil investigation problem

If research work in forestry in Great Britain is to achieve progress and be of practical utility, it will be necessary to enthuse all research centres and pure science research specialists throughout the country, and the programmes of research, under the different aspects required (as indicated by the forestry authorities), should be drawn up by the scientific investigators involved In this way the principles and aims of forestry will become better understood by the latter, whilst the public will be assured, in so far as human agency can assure it, that the money being sunk in forestry is not being wasted

Scientific Inference

Scientific Inference By Dr Harold Jeffreys Pp vii + 247 (Cambridge At the University Press, 1931) 10*s* 6*d* net

SCIENTISTS generally care so little for scientific principles that the title of this book may repel as many as its author's name attracts Let it be, therefore, stated at once that it is not a formal treatise, but a collection of essays of which some have a value independent of the doctrines they illustrate Everyone with a logical mind will enjoy Chapters vii, viii, ix, in which it is shown how three great branches of mathematical physics, mensuration, Newtonian dynamics, light and relativity, can be developed concisely from the minimum of experimental fact, and everyone will find something novel and suggestive in Chapter x, on miscellaneous questions

However, the main purpose, indicated by the title, is to expound the views that the papers of Drs Jeffreys and Wrinch have made familiar to those who study the logic of science This view is explained generally in Chapter i Probability is the fundamental notion in scientific inference, all propositions have a comparable, and therefore measurable, 'probability on the data", general propositions cannot have high probability unless they are 'mathematically or logically simple" On these grounds it can be shown why the "classification of sensations" that science actually adopts is to be preferred to any other Chapters ii, iii, together with certain appendices, develop the necessary calculus, Chapters iv, v, vi apply it successively to quantitative laws, errors, physical magnitudes

Chapter ix, on other theories of scientific knowledge, will seem to many readers the most important of all For the feeling that discussions of scientific inference are necessarily barren is undoubtedly due to the contrast between the agreement concerning what is actually true in science and the disagreement concerning why it is true Whether Dr Jeffreys has succeeded at all in reducing this disagreement must be decided in the first instance by those whose theories he criticises But it is permissible to point out that he has noticed only theories with some similarity to his own, and that even if he abolished all discrepancies between these theories, there would still remain others who reject the most fundamental postulates from which his arguments start Prof Bridgman's theory belongs to this class, I think, my own certainly does perhaps I may show very briefly how completely irreconcilable our views are

I maintain that the only propositions that have a measurable probability are those concerned with the happening of future events of the kind that can be shown experimentally to possess a measurable chance, such propositions form a very small fraction of all scientific propositions * I maintain further that all scientific inference hangs on certain primary laws more fundamental than any that Dr Jeffreys has considered, and, in particular,

* Thus I deny that as Dr Jeffreys first postulate demands, the probability on the data of any one of the following three propositions is greater than, less than, or equal to that of any other —The year 1933 will be wetter than 1934, There is extra terrestrial life King Alfred is one of my ancestors The first will the second may, the third will not some day be known to be definitely true or false

that mathematical conceptions cannot be logically introduced into science until the non mathematical laws that underlie measurement (and its inevitably associated error) have been investigated

Can such extreme disagreement be resolved? If it cannot, what is the use of all this discussion? An obvious suggestion is that the disagreement arises from a preoccupation with one of the two distinct forms of scientific activity, experiment and explanation, to the exclusion of the other and that a thinker may arise some day, equally at home in the laboratory and in the study, who will weld these partial views into a single complete whole The first part of this suggestion may be accepted without the second, personally, I hold that certain outlooks are essentially antagonistic, that, outside the narrow bounds of pure science and pure mathematics, one man's truth may really be another man's error, and that mathematical science is the highest form of intellectual activity just because it permits co operation, and not mere toleration, between diverse minds But even if that is true, the discussions have some value At the lowest, they amuse those who take part in them, at the highest, they sometimes reveal an agreement in unexpected places, which should surely be regarded as peculiarly significant

If there were a generally accepted theory of scientific inference, it would probably have little influence in determining the course of scientific investigation, but it might have a great influence in determining the form in which conclusions were presented, particularly for instruction Scientific education might cease to be mere absorption of unco ordinated facts and become a training in precise thought That stage has not yet been reached, but some small steps towards it have been taken It is encouraging to find that even Dr Jeffreys and I can agree in condemning certain features of the theory of measurement that pervades our text books and it is not too optimistic to hope that our grandchildren will be taught the difference between fundamental and derived magnitudes and be no longer confused by nonsense about dimensions

NORMAN R CAMPBELL

Science and Parenthood

The Retreat from Parenthood By Jean Ayling Pp xvi+293 (London Kegan Paul and Co, Ltd, 1930) 10s 6d net

IN "The Retreat from Parenthood", the author makes a vehement plea for the application of science to life in all the small details of home comfort, child-rearing, and marital relations—a plea for the emancipation of these provinces from the domination of age old formulæ and customs It is suggested that the traditional machinery of home life is particularly ill adapted to the rearing of healthy and happy children, and that those more intelligent sections of the community typified by the professional classes will tend increasingly to curtail their reproductive activities unless biological ideals are applied to modern life It is an acknowledged and deplored fact that during the last twenty or thirty years the birth rate among the professional classes has fallen to an alarming extent The author examines the causes of this curtailment of fertility and her analysis makes depressing reading, indeed, if her diagnosis is correct, the vast majority of men and women of intelligence must be living most unhappy lives, dominated by the tyrannical inefficiency of modern life

In the first part of the book, a survey is made of the conditions in modern homes the practical difficulties connected with running homes in a world where science, while having revolutionised commerce, transport, production, and amusements, has scarcely, if at all, penetrated to the individual household, the unfitness of most men and women, by reason of their upbringing and incomplete education, for happy marriage and intelligent parenthood, the traditional shroud of mystery surrounding child-bearing, which prevents any but the most determined of women from obtaining the knowledge necessary to produce children without undue physical and mental injury to themselves and to their offspring the economic and social influences which in so many cases relegate the child bearing woman to a life entirely devoid of mental activities, with consequent harm to herself, the children, and conjugal relations

In the author's opinion, the most important factors determining the present decline in birth-rate in the professional classes are the prevalence of the idea that from the womb to the school door the needs of the child must be supplied within the family as a unit, the fact that, in so many cases, women determined to bear children have to pay the price of exile from professional fields, while women determined on a professional life-work have to pay the price of sterility If the provision of healthy and intelligent children is regarded as one of the most important services that any man or woman can render the community—and by a large section of our generation it is so regarded—then this penalisation of parenthood requires explana-

tion, especially since this obstructive attitude is directed particularly against those women who, by reason of sound physique, trained intelligence, and high ideals, are undeniably best fitted for maternity

The author maintains that, instead of adapting the biological needs of the race to professional regulations, it might be possible to adapt professional regulations to biological needs Accordingly, a scheme is outlined in the second half of the book for arresting the decline of birth rate among professional workers, taking due account of the factors at present predisposing to failure, whereby services would be provided by a co operative organisation to deal with all phases of child rearing Great stress is laid on the necessity for easily available, up to date medical supervision for the child from the moment of conception until it reaches school age

The book suffers from diffuseness, repetition, and, above all, from irritating mannerisms and a certain immaturity of style reminiscent of the college debating society But it is an illuminating account of the difficulties encountered by women attempting to conduct their parenthood in a sane and unsentimental way, and is a strong indictment of the progress of medical knowledge and availability of that knowledge on all matters concerned with pregnancy and child rearing The problems are difficult of solution and there is urgent need for organised research in this, as yet, almost virgin field But the author justly remarks "No one can visualise the splendour of man's material achievements without wondering why for so long the human race has neglected its own needs "

M A

The Wry-mouthed Feather-stars

Smithsonian Institution United States National Museum Bulletin 82 *A Monograph of the Existing Crinoids* By Austin Hobart Clark Vol 1 *The Comatulids* Part 3 *Superfamily Comasterida* Pp vii + 816 + 82 plates (Washington, D C Government Printing Office, 1931) 2 dollars

IT is ten years since the second part of this elaborate monograph was published, but, considering the enormous amount of detail here assembled after personal checking by the author, one cannot complain of undue delay

The unstalked crinoids herein discussed are those with the anus in the centre of the oral face and with the mouth consequently excentric Though all are included in a single family Comasteridæ (formerly Actinometridæ), they are here placed in a superfamily Comasterida The object of this conception, which we owe to Gislén, is to contrast them with the super families Tropiometrida and Mariametrida, which with the Comasterida make up the curiously named Oligophreata, one of the two sub-orders of the Comatulida The Comasteridæ again are subdivided into three sub families—Capillasterinæ, Comactiniinæ, and Comasterinæ, and these between them cover nineteen genera As moderately familiar examples we may mention *Comaster* itself, based by L Agassiz on *Comatula multiradiata* Lamarck, a species that has given occasion for much controversy and *Comatula* Lamarck, with genotype *C solaris*, of which *Actinometra* Muller and its genotype *A imperialis* are respectively synonyms These two species exemplify in intensified degree that variability which renders the identification of all these animals a task of perplexing difficulty, enhanced in practice by the mutilation of most available specimens Those confronted with the problem will be grateful to Dr Clark for his careful diagnoses and elaborate keys, which, as he says, should be followed very closely and literally

The more general worker will value the introduction, which traces the development of the scheme of classification adopted in the present monograph To that development the largest contributor has been Dr Clark himself in a long series of papers, of which summaries are here given Other writers, especially T Gislén, are also mentioned Besides this, the synonymics and references to literature at the head of each classificatory division give a brief précis of nearly every work cited In view of these remarkably complete and detailed references, it is not easy to understand why on pp 76 and 81 Dr Clark assigns the establishment of the family Actinometridæ to himself in 1907 That family, with Atelecrinidæ and Thaumatocrinidæ, was already defined in the Echinoderm volume of "A Treatise on Zoology", edited by Lankester in 1900

The numerous photographs of specimens reproduced in half tone on 82 plates (back to back) add to the appearance and weight of the volume and make one marvel the more at its remarkably low price It may, however, be doubted whether they are so useful for purposes of identification as the outline drawings of special structures used in previous volumes There is an index to systematic names, but a complete index to vol 1 is promised for part 5 We wish Dr Clark health and strength to complete his great work F A BATHER

A Survey of Television

(1) *Television To-day and To-morrow* By Sydney A Moseley and H J Barton Chapple Pp xxiii + 130 + 47 plates (London Sir Isaac Pitman and Sons, Ltd , 1930) 7s 6d net

(2) *A B C of Television, or Seeing by Radio a Complete and Comprehensive Treatise dealing with the Theory, Construction and Operation of Tele photographic and Television Transmitters and Receivers, written especially for Home Experimenters, Radio Fans and Students* By Raymond Francis Yates Pp viii + 210 + 13 plates (London Chapman and Hall, Ltd , 1929) 10s 6d net

(3) *Television Present Methods of Picture Transmission* By Dr H Horton Sheldon and Edgar Norman Grisewood Second printing Pp x + 194 (London The Library Press, Ltd , 1930) 10s 6d net

THESE three books together furnish a useful survey of television up to 1930 There have doubtless been subsequent developments It may be convenient to deal first with the work by S A Moseley and H J Barton Chapple This consists of a review of the work of J L Baird, who furnishes a foreword The other two volumes, which are of American origin, are of a more general character

(1) Mr Moseley and Mr Chapple deal with what is usually regarded as the real process of television, that is, the conveyance to a distance of a picture of something actually occurring at that instant, which may include moving objects The wireless transmission of drawings, photographs, signatures, etc , by a graphic process that is far from instantaneous is really a different problem, though naturally also of great scientific interest Mr Baird's foreword refers to the difficulties in securing facilities for broadcasting and the limitations imposed by the narrow waveband available, which at present leads to images being restricted to simple scenes He contends, however, that the number of pictures sent per second (about 12½ on his systems) need not be nearly so great as in cinematography

The "History of Television", which forms the first chapter to this work, makes references to the early pioneering work of Nipkow (1884), and to the transmission of silhouettes by Jenkins (1925) , but regards the demonstration by Mr Baird, described in NATURE of July 3, 1926, and quoted by the authors, as the first instance of the wireless transmission of real images In subsequent chapters the details of the apparatus are explained It is shown how the object is illuminated by intermittent light, the reflection of which excites changing currents in a photoelectric cell, how such currents are transmitted, magnified, and ultimately operate at the receiving end a neon lamp, which reacts instantaneously to each change in current, and how scanning discs at the transmitting end and carefully synchronised complementary discs at the receiving end serve to produce the illusion of an actual image The process, in this and other systems of television, is equivalent to selecting and conveying each element in a picture in turn, but with such rapidity that an apparently complete picture is presented The reproduced pictures, thus formed by a series of luminous lines, are certainly recognisable portraits The authors suggest that the equipment is relatively simple and within the scope of the amateur Efficient results, however, obviously demand technical skill, and perfect synchronisation at the transmitting and receiving ends demands great care

The concluding chapters are concerned with subsidiary recent developments, in themselves highly ingenious and interesting, but presumably requiring greater perfecting of the main process before they can be applied in practice We have, for example, 'phonovision', a process involving the reproduction on a gramophone record of rhythmical sounds, corresponding to the changes in the photoelectric current, which are thus stored, and can be released at any time in order to repeat a television image The authors also discuss the possibilities of colour and stereoscopic effects The former involves two scanning discs and two sources of light, one of neon gas furnishing red light, the other a combination of helium and mercury vapour, furnishing yellow, green, and blue Stereoscopic effects would require two identical but distinct sources and duplicate spirals on the scanning disc permitting 'double exploration' Of considerable interest also is the 'Noctovisor' apparatus, which consists essentially of a television transmitter and receiver coupled together but adapted to respond to infra red rays It is claimed that with such an apparatus a mariner could detect the presence of a distant source of light, even though completely shrouded by fog

(2) "The A B C of Television", by Mr R F Yates, is conceived on somewhat broader lines A chapter is devoted to "telegraphing pictures" Prior to this there is a review of existing television systems, which includes a useful explanatory diagram showing the details of transmitting and receiving ends The experiments made in the Bell Telephone Laboratories are described in detail, one

interesting feature being the use of a neon tube image-forming grid with no less than 2500 independent electrodes Other experiments mentioned are those of Max Dieckmann (based on the movement of cathode rays) in Germany and Belin and Holweck in France Subsequent chapters deal with photoelectric cells, amplification, the neon lamp, the problem of scanning, synchronisation, etc

(3) Dr Sheldon and Mr Grisewood, in their historical survey, deal mainly with the conveyance of pictures by telegraph and devote only a small space to television proper Subsequent chapters deal with optical systems and the eye, electro magnetic waves, selenium and photoelectric cells, glow-lamps and telephotography In Chapter xii and subsequent chapters, there is to be found what is perhaps the best review of various systems of television occurring in these volumes The Baird, Bell, Jenkins, and Alexanderson systems are dealt with successively

One cannot escape the feeling that the moving mechanism imposed by all these systems does not represent a final solution A final chapter points out, however, that the technical difficulties of television, great as they are, may be surpassed by those involved in a general process of broadcasting Had television arrived before the era of audible wireless, the use of the somewhat broad range of wave-lengths necessary for good reception would have presented little difficulty, to day, possible interference with the existing wireless broadcasting systems all over the world has to be considered

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1931 Edited by Sir H Frank Heath Published for the Universities Bureau of the British Empire Pp xiii + 917 (London G Bell and Sons, Ltd, 1931) 15s net

THIS annual, first published in 1914, is primarily a conspectus of the staffs, organisation, and activities of universities, the numerous colleges connected with them, and a few other, unattached, colleges situated in various parts of the British Empire, as follows

	Universities	Unattached Colleges
England	11	4
Wales	1	
Scotland	4	
Ireland	3	
Canada	21	
Newfoundland		1
West Indies [1]		1
Australia	6	
New Zealand	1	
South Africa	5	
Mauritius [2]		1
Malta	1	
Palestine [3]	1	
India	18	
Ceylon [4]		2
Singapore [5]		2
Hong Kong	1	

[1] Imperial College of Tropical Agriculture Trinidad
[2] College of Agriculture
[3] Mandated Territory The Hebrew University, Jerusalem
[4] Medical College and University College, Colombo
[5] King Edward VII Medical College and Raffles College

From the calendar of each of these institutions have been selected such items of information as are likely to prove of interest to the members of other universities, schoolmasters, persons engaged in scientific researches, government departments, clubs, and the general public A directory of the officers and members of the staff of each university is followed by information as to its constitution, equipment, residential accommodation, courses of instruction, fees, scholarships open to graduates, extra mural work, publications, etc, and a summary of events of outstanding interest which occurred during the past academic year, with statistics of the number of students in attendance and degrees, diplomas, etc, conferred In the staff directories the names are grouped under subject headings and an additional indication is thus afforded of the scope of the instruction offered An alphabetical index at the end of the volume contains upwards of 12,000 names

In chapters introductory to the sections dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa, and of India, respectively, are given summaries of information regarding their history, regulations, and practice, but not reviews of the academic year The Canadian chapter has been largely rewritten for this year's issue by Dr Stanley Mackenzie, of Dalhousie University, and now gives British readers a clearer idea of a series of developments of extraordinary interest The Canadian universities are kept in touch with one another by annual conferences, the fourteenth of which was held in May 1930 at Toronto, and by co operation with a National Council of Education which organises triennial conferences, the next of which will be in Toronto in 1932 The Australian universities, like the Canadian, hold conferences, which are arranged by a Standing Advisory Committee established in 1920 Similarly, in South Africa, since 1923, representatives of the universities and university colleges have met from time to time to discuss matters of common interest These universities,

moreover, have statutory powers to make joint regulations regarding matriculation, professional examinations, etc. The Indian universities set up in 1924 an Inter-University Board which meets annually: it has published a handbook of Indian universities. The question suggests itself whether it would not be worth while, with the help of these various co-ordinating organisations, to add to the introductory chapters annual reviews of the past academic year.

Appendices, extending to 170 pages, include summaries of the conditions governing admission, in Great Britain and Ireland, to the universities and to the medical and other professions and careers for which university studies are a fitting preparation, lists of open post-graduate scholarships, fellowships, etc., both British and foreign, and lists of centres of scientific research and information in the Empire, whether connected with universities or not, to which independent research workers are admitted. These lists have been greatly extended and rearranged and, of course, brought up to date. The aids open to British students in Great Britain and Ireland have now been arranged by grouping under subjects of study instead of under the names of the institutions offering the aid. This has not been done in the case of the Dominions and foreign countries, because the number available was too small. Anyone desiring to discover the relative amounts of provision of this kind made by universities, governments, scientific societies, or other bodies, can easily collect the information by using the general index.

The centres of scientific information in Great Britain are grouped under the four heads—botany and agriculture, industrial, pure science, and medical; the centres of research under these heads and forestry, fisheries and tides, and meteorology. The list of centres of research and information in the Dominions, India, and the Colonies is much fuller than before.

The extent and variety of the ground covered in the "Yearbook", especially the appendices, are such that the labour expended on it would be to a large extent wasted unless it were furnished with an adequate general index. This matter has evidently received the attention it deserves. In connexion with the indexing of the names of staff and officials, the treatment with any kind of uniformity of the Indian, Burmese, and other Oriental names presents extraordinary difficulties which the editor seems to have grappled with successfully.

Glancing through the summaries of events of the past year, one sees many significant items. Among the lists of benefactions one finds numerous gifts from American philanthropic foundations associated with the names Carnegie and Rockefeller. The beneficiaries include, naturally, many of the Canadian universities, eight of which participate in the benefits of the pension scheme of the Carnegie Foundation for the Advancement of Teaching, and the Universities of London, Cambridge, Durham (Armstrong College), Tasmania, Otago (New Zealand), and the Witwatersrand and University colleges at Exeter and Christchurch (N.Z.).

The 1931 "Yearbook" will have more than ordinary importance by reason of the fact that the fourth Congress of the Universities of the Empire is to be held this year, July 7–10, at Edinburgh. The previous congresses were held in 1912 (London), 1921 (Oxford), and 1926 (Cambridge).

Our Bookshelf

The Psychology of Clothes. By Dr. J. C. Flugel. (The International Psycho-Analytical Library, No. 18.) Pp. 257 + 17 plates. (London: The Hogarth Press, 1930.) 21s.

BOOKS which deal with dress from any but the historical point of view are only too few, and it is therefore refreshing to meet with a new one. Dr. Flugel's Psychology of Clothes should be read by everyone who takes an interest in modern garb, for it contains a wealth of facts and theories bearing on its origin, its effects, and its future.

To the widespread belief that clothes originated to enhance the attractiveness of the wearer, the author adds another, that they were intended to direct attention to the sexual organs. He further contends that garments may actually represent these, but his examples do not seem to be very convincing. To-day he finds the essential opposition between the motives of decoration and modesty to be the most fundamental fact in the whole psychology of clothing.

In the chapter on "Individual Differences", Dr. Flügel recognises a number of types, among them those who like to feel their skin uncovered and their muscles unhampered. Of these, some never get resigned to dress. Then there are unemotional individuals whose feelings fuse clothes and body into an harmonious whole.

One of the most striking matters touched upon under the heading of "Sex Differences" is the "great masculine renunciation", or sudden reduction in male decorativeness at the end of the eighteenth century, which it is claimed was connected with the French Revolution.

In discussing the "Why of Fashion", it is explained that the higher classes, when their sartorial distinctions are gradually appropriated by the lower, seeing that sumptuary laws seldom prove effective, adopt a different dress in order to re-establish their signs of superiority. In our days of levelling up, however, we are inclined to look for

commercial influences behind the scenes, which result in mistress and maid both wearing—shall we say?—'Russian boots'

Dr Flügel dwells in detail on other matters connected with fashion, and devotes a chapter to the "Evolution of Garments", a subject to which Sir George Darwin first directed attention

W M W

Principles of Soil Technology By Prof Paul Emerson Pp xv+402 (New York The Macmillan Co, 1930) 14s net

THE success in the arrangement and presentation of the subject matter in this book is the result of long teaching experience by the author This branch of agricultural science has progressed rapidly in recent years, and it is essential, therefore, that the establishment and development of the fundamental principles involved should be clearly understood by the student

The four sections of this book are (1) soil genesis, morphology, and classification, (2) soil physics, (3) soil chemistry, (4) soil biology In the first section the author stresses rightly the importance of studying the soil *in situ* Readers will appreciate the definitions and explanations that are given of the many less familiar terms used in soil classification and morphology, together with a description of the soil areas of the United States The presentation of soil physics to a student, without entailing the use of an advanced treatise on mathematics, is a difficult task The author has, however, succeeded, and conveys to the reader the essential principles and the results of recent work on soil structure air, and water movement, and their effects on plant growth Equally well treated is the section on soil chemistry, where the mechanism of base exchange is explained, as well as the source and utilisation of plant nutrients It should be pointed out, however, that a wrong impression of the salts of ortho phosphoric acid is given on p 242 All secondary and tertiary phosphates are not water insoluble, nor is the use of the descriptive terms, acid soluble and insoluble, for these, very fortunate Both forms, if we consider the case of calcium only, are soluble in dilute weak acids

Apart from this, the book is very well written It contains, in addition to the sections already mentioned, a very useful glossary of terms, numerous tables, graphs, diagrams, and maps of the United States

The excellent printing and binding make reading a pleasure, the price is low, and the references to the literature will be useful to post graduate workers

Elementary Biology for Matriculation and Allied Examinations By Mary E Phillips and Lucy E Cox Pp xiv+480 (London University of London Press, Ltd, 1931) 7s 6d

Now that biology has been introduced by all examination boards of England and Wales for the school certificate, as well as in many cases for the matriculation examinations, we may expect an outcrop of British text books in a field which hitherto has been largely in the hands of American authors The book under consideration is one of the first of the new series to enter the lists, and though primarily designed for matriculation examinations, its authors express the hope that it "may also prove useful in those schools in which biology is studied as a cultural subject" And why not? It is attractively written, well printed, and copiously illustrated No pains have been spared to render into assimilable form the subject matter, which is marshalled into five well balanced sections Thus (1) Simple living forms of increasing complexity, (2) external morphology and mode of life of some members of the chief classes of animals, (3) general morphology and physiology of the mammal (4) general morphology and physiology of the flowering plant, (5) the soil, bacteria, parasites and saprophytes, distinction and interrelation between plants and animals

With discrimination, the practical work is sifted from the text and collected at the end of each chapter The 282 illustrations cover a wide range of subjects, a very large proportion of them have an accuracy of finish which is not always associated with elementary text books There is no chapter on evolution, but the outlook of the authors is quite clear from their all too short "Introductory", while only the dullest reader could fail to be stimulated to think on evolutionary lines, by many remarks in the text

A Handbook of Physics Measurements By Ervin S Ferry, in collaboration with O W Silvey, G W Sherman, Jr, D C Duncan and R B Abbott Vol 2 *Vibratory Motion, Sound, Heat, Electricity and Magnetism* Third edition Pp xi+277 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1929) 12s 6d net

THIS book is devoted to measurements in vibratory motion, sound, heat, electricity and magnetism Practical details are preceded by a theoretical treatment which should enable the student to understand what he is doing The considerable space allocated to the theory of damped vibrations and the logarithmic decrement is welcome in view of their importance in relation to alternating currents, though in this connexion it is a pity that the theory of forced vibrations has not been included

A Junior Course of Practical Zoology By the late Dr A Milnes Marshall and the late Dr C Herbert Hurst Eleventh edition, revised by H G Newth Pp xliii+519 (London John Murray, 1930) 12s net

NOT many scientific text books first published in 1887 have still a demand in the laboratories of to day, at least in anything like their original form In preparing the eleventh edition, Mr Newth was probably well advised not to introduce physiology, which would, as he says, "have added greatly to its bulk, and the result could only have been a hybrid of very doubtful viability" In its present form, the book is likely to retain its position as the standard work on animal morphology for junior students

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Action of a Crystal as a Two-Dimensional Lattice in Diffracting Electrons

KIKUCHI[1] first described examples of electron diffraction in which a crystal appeared to behave as a two dimensional or cross grating Very thin sheets of mica give an equilateral net like pattern of diffracted beams on the photographic plate (the N pattern), as if the only conditions for interference were those required by the lattice net of the mica cleavage plane Kikuchi further showed that, with increasing thickness of the mica, some spots are enhanced and others weakened until what he termed the L pattern is obtained The selection of the enhanced spots was accounted for satisfactorily by the operation of the third condition for interference, which depends on the regular repetition of the crystal structure in successive planes The L pattern, in other words, is explained by diffraction at a three dimensional lattice, in the manner familiar in the case of X rays

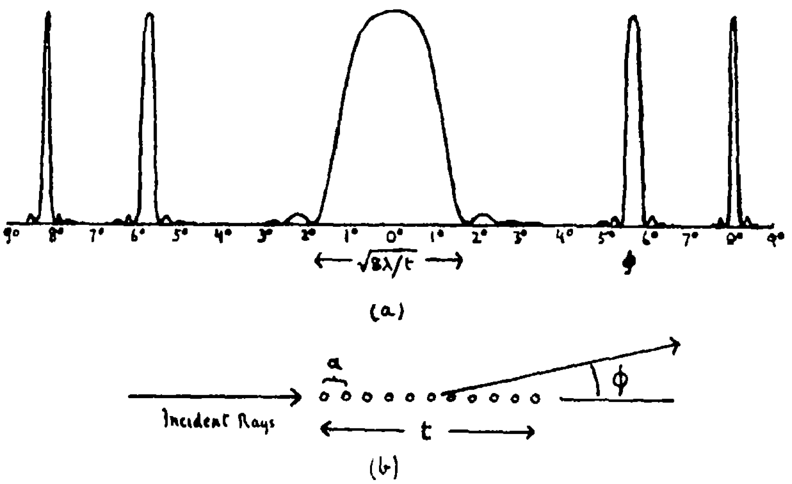


FIG 1

Linnik[2] obtained patterns somewhat like Kikuchi's N pattern, with copper K_α rays and mica which had been heated He suggested that they were due to a breaking up of the mica into sheets so thin that each acted as an independent two dimensional grating W L Bragg put forward an alternative explanation[3] that Linnik's effect was due to a slight distortion of the mica, which might be described as a random orientation of the normal to the cleavage plane over a small range It was suggested that a similar explanation might account for Kikuchi's N pattern

Certain experiments on electron diffraction by very small crystals made by one of us (F K) seem to show very clearly, however, the disappearance of the third condition for interference, namely, that depending on the repeat of the crystal pattern in the direction of the incident beam It is interesting to examine how thin a crystal must be for this condition to become inoperative

Let a row of n scattering points with spacing a be parallel to the incident rays, as in Fig 1 (b) The intensity of radiation scattered in a direction Q is proportional to $\sin^2 n\psi/\sin^2 \psi$ where $\psi = \pi a(1 - \cos\phi)/\lambda$. This curve is plotted in Fig 1 (a) for the case where $\lambda = 0\ 05$ A , $n = 10$, $a = 10$ A (thickness of crystal $t = na = 100$ A) Its interesting feature is the breadth of the central maximum, which is nearly 4° ($2\phi_0 = \sqrt{8\lambda/t}$) For all directions within this range, the whole row acts as a single diffracting unit and gives a strong resultant effect *

In actual cases of electron diffraction by a small crystal, the wave length is so short (0 05 A for 60,000 volts, as compared with 1 54 A for copper K_α) that many diffracted beams appear at angles well within this range The crystal in a fixed orientation can therefore give simultaneously a complete series of cross-spectra, for the crystal may be considered as a cross-grating of these rows, each of which acts as a single unit For example, in the case considered above, if the crystal also had spacings of 10 A at right angles to the beam, the cross spectra would be 17′ apart and more than one hundred would appear within the central maximum The difference between the patterns of X ray diffraction and electron diffraction is apparent, it is not merely one of angular scale For the row to act as a unit, it is necessary that $t(1 - \cos\phi) = t\phi^2/2 < \lambda$ When ϕ is small, $t\phi^2/2$ is a small quantity of the second order, and the condition is readily satisfied for directions of electron diffraction and crystals of the order of 100 A in thickness In the case of X rays, the 'cross grating' spectra fall outside the central maximum when the crystal is more than one or two atomic planes thick, and we have the familiar effect that only one diffracted beam is formed at a time, and that only appears when the crystal is correctly oriented

We may picture electron diffraction by a small crystal as follows Whenever the crystal is so oriented that a zone axis (row of scattering points) is approximately parallel to the incident beam, a complete cross-spectrum flashes out The cross grating is the projection of the crystal on a plane at right angles to the zone Such an orientation is a very special case More generally, when the crystal is so oriented that a set of planes is nearly parallel to the rays, the crystal acts as a *line grating* and forms several orders simultaneously on either side of the central beam

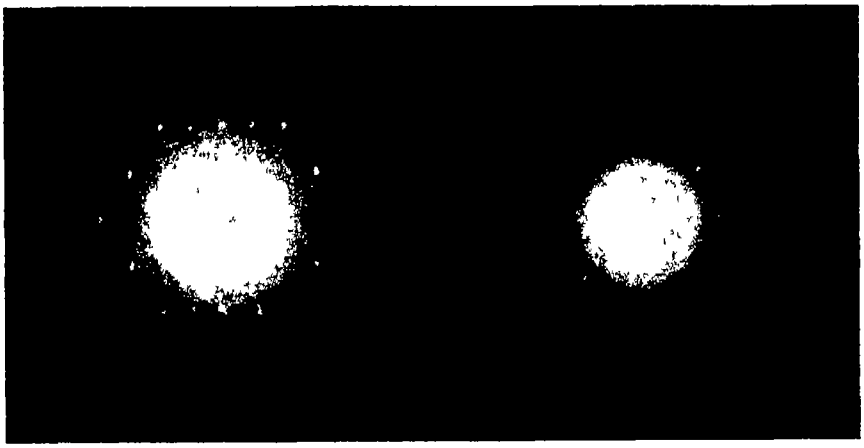
Both cases are shown in Fig 2 A powder photograph, taken with a coarse powder, has spots on the Debye Scherrer rings due to individual crystal grains These spots, in the case of electron diffraction, mostly occur in pairs symmetrically placed on either side of the central spot Each crystal grain is obviously diffracting spectra to both sides simultaneously The effect is very marked in powder photographs of sodium fluoride, where more than one order often appears on either side, but these photographs are difficult to reproduce here Fig 2 (b), which shows the same effect, is taken with crystalline matter in a collodion film, and the centro symmetry is very striking In Fig 2 (a), a single crystal chances to have a zone axis parallel to the beam, and the complete cross spectrum appears. These sheets were less than 100 A in thickness

We were privileged to hear recently a lecture by Dr Eisenhut in which slides of similar cross grating spectra produced by single crystals of cadmium iodide

* G P Thomson ("Wave Mechanics of Free Electrons", p 72) refers to the same feature in discussing the extent of the electron wave packet

and iron oxide (Fe_3O_4) were shown (O Eisenhut and E Knapp, I G Farbenindustrie Forschungs Laboratorium, Oppau)

This explanation is only partial, because the patterns are often more extended than any broad central diffraction maximum which is probable The central maximum can be seen in Kikuchi's photographs (for example, Fig 5, loc cit), but the corresponding mica thickness proves to be 200 A , which is much smaller than Kikuchi's estimate for the sheets he used In the single crystal photographs, the pattern is sometimes so extended as to indicate impossibly small crystal thicknesses It is interesting to note, however, that theoretically a small three dimensional crystal produces the effect of a two dimensional grating and gives a number of diffracted electron beams simultaneously Its dimensions at right angles to the beam can be sufficiently great to give a sharp cross grating spectrum, while an equal depth in the direction of the beam is insufficient to bring in the third condition for interference



(a) Fig 2 (b)

W L Bragg
F Kirchner

Munich, March 1931

[1] *Japanese Journal of Physics*, vol 5, No 2
[2] Nature, 123, 604, April 20, 1929
[3] Nature 124 125, July 27, 1929

The Velocity of Light

In a recent discourse broadcast by the B B C, reference was made to my communication in Nature of April 4 on the subject of the velocity of light Two objections were presented to the deduction that the velocity of light decreases, derived from the values quoted , these must have occurred to the readers of my letter, so that perhaps I may be allowed to refer to them briefly

(1) The possible errors do not rule out the possibility that the values are evaluations of a constant I stated this myself Physicists, however, are apt to overlook the fact that possible errors are no guide whatever in such a case as the one occupying our attention They are a mere mathematical guess as to the accuracy of any individual determination, and no more They leave entirely out of account the fact that observers, methods, apparatus, conditions, etc , may be different Of course, identical results from different observers have more weight than if the observers were the same person, and similarly for the methods, apparatus, etc For example, the value of a constant for which two different observers, working with entirely different techniques, have obtained results such as, say, 126 ± 50 and 128 ± 60 respectively is far more likely to be in the vicinity of either value, and therefore far better established, than if a single observer had obtained say, 102 ± 4 and 152 ± 6, using the same method and apparatus What is true of the constancy is also true of any law of variation

(2) In my letter, I have limited myself to determinations made in the present century This does not mean at all that I have rejected values obtained before which were acknowledged as being reliable Those who quote these earlier values without having made a thorough investigation, such as that which was published in Nature, Sept 17 and Oct 22, 1927, little realise how they allow themselves to be misled by a mere number alongside a name The value 299,853 obtained by Michelson in 1882, for example, has been mentioned as disproving a decrease of the velocity of light, when considered together with the four determinations I gave in my letter The fact is overlooked that this determination is one of three, made on relatively short bases, and therefore more liable to be affected by systematic errors of a given magnitude than the values obtained over very long bases or with a technique giving results of an equivalent order of physical accuracy, such as that of Karolus and Mittelstaedt, in which the high order of frequency of interruption of the luminous beam compensates for the shortness of the base These three values are

Michelson	1879 5	299,910 ± 50 km /sec
Newcomb	1882 7	299,860 ± 30 ,, ,,
Michelson	1882 8	299,853 ± 60 ,, ,,

They were obtained by two observers in close relationship, using the same method and the same experimental technique, with apparatuses which were similar , they constitute a set of their own, being the only observations made on such short bases (excluding the pioneer experiments of Foucault, which are admittedly mere attempts to ascertain the possibilities of the method) Now, each of these observations gives a result smaller than the one before ! The one before that of 1879 5 is Cornu Helmert's value, 299,990 ± 200 They, therefore, demonstrate a decrease of velocity, during the period which they cover , at any rate, their distribution along a perfect straight line, which, moreover, points exactly towards Cornu-Helmert's value, cannot be said to be accidental, any more than their agreement in giving a constant value, if they did so, could be said to be accidental !

I have treated the whole question at full length in a series of articles in *Ciel et Terre* (*Bulletin de la Société Belge d'Astronomie*, 1927–1931) In these, I establish the twenty two coincidences referred to in my letter There is not a single one against a decrease of velocity Can this be accidental?

Another point to be remembered is that the method of the revolving mirror, used by Michelson, is based on assumptions which, to my knowledge, have not yet been proved, namely, that the laws of oblique reflection on a moving reflecting surface, having a speed which is small compared to that of light, are the same as if the surface was at rest, and that the laws of

reflection of a pencil of light from a source, real or virtual, having a transverse speed of the same order as that of light, are the same as if the source was at rest

M. E. J. GHEURY DE BRAY

40 Westmount Road,
Eltham, S.E. 9,
April 23.

Deep-Focus Earthquakes

WITH reference to Mr. Scrase's letter in NATURE of Mar. 28, p. 486, a few additional remarks concerning deep focus earthquakes may be of interest. Such earthquakes are comparatively rare occurrences, and in the years 1918–1926 the late Prof. H. H. Turner reported only 138 in the "International Seismological Summary".

Turner's very great focal depths, amounting in one instance to 0·090 of the earth's radius below normal had to some extent fallen under suspicion, for three reasons:

(1) His depth of 0·040 for a normal earthquake shock is certainly faulty; the Montana earthquake of June 28, 1925, examined by Byerly, was not found by Turner to have an abnormally *high* focus, yet Jeffreys was able to show that the time distance curve agreed with that found for the Jersey and Hereford earthquakes of 1927, for which the foci were less than 20 km. deep, and he furthermore deduced from Byerly's curve a set of corrections to the Zoppritz-Turner tables that agreed with a set inferred by Turner from the residuals of a very large number of earthquakes.

(2) Turner's estimates of focal depth depended upon Knott's seismic rays which were in turn calculated from the Zoppritz-Turner tables; the known errors of these tables, particularly for small epicentral distances, require a revision of Turner's focal depths.

(3) The crucial test had not been applied to Turner's deep focus earthquakes that in view of a general reciprocal theorem in dynamics, the amplitude of a surface wave generated by a deep focus disturbance should be small if the amplitude of the disturbance of a wave of that type is relatively small at the depth in question (cf. H. Jeffreys, 'The Earth', 2nd edn., p. 136). Actually, the presence of *L* and *M* readings in the "International Seismological Summary" for many of the earthquakes of supposed very deep foci seems *prima facie* to constitute a valid objection to presuming foci of these depths.

As regards (1), it seems definite that Turner's value of the normal focal depth must be abandoned; (2) awaits the thorough testing of much improved tables, but a definite answer may be expected in the near future; (3) has recently been the subject of a detailed investigation, and the result which I am publishing in the forthcoming number of *Gerlands Beiträge* entirely supports the idea of abnormal focal depth, at any rate for the additional focal depths of 0·040 and more; a further investigation is being undertaken for depths of less than 0·040 below normal. The typical deep focus earthquake is most interesting; most of the energy is carried by body waves, and *P*, *PP*, *PPP*, *S*, *SS*, *SSS* are of very great amplitude; at the time where *L* and *M* normally appear there is a disturbance which is just the general motion corresponding to the dying down of the distortional waves. This weakening of the normal long wave phase is, of course, one of the distinctive features that Mr. Scrase refers to.

There is one partial exception to the previous statement. Although the normal *L* and *M* phases are practically absent from the shocks of very great depth, the phase known as *G*, Gutenberg's "Early Long Wave", of velocity about 4·4 km./sec., is often still discernible, although of rather small amplitude. It is to be expected that this wave of very long period should be sensible at much greater depths than the long waves of the normal *L* and *M* phases.

There is no difficulty in explaining the recorded *L* and *M* of the 'International Seismological Summary". A graph shows at once that they are sometimes *G*, but more often the large amplitudes of *S*, *SS*, *SSS*, so conspicuous in these deep focus shocks, are mistaken for surface waves.

It is greatly to be regretted that Prof. Turner, who carried out so many of the pioneer investigations of focal depths and to whose energy and enthusiasm their systematic study and report in the "International Seismological Summary" are due, has not lived to see the confirmation, both by the reciprocal theorem argument adduced by Dr. Jeffreys and by the important method discovered by Mr. Scrase, of the occurrence of abnormally deep foci.

R. STONELEY.

The University, Leeds,
April 17.

Opacity and Stellar Structure

THE emission of the nuclear γ-rays from radioactive elements is accompanied by the photo-electrons emitted from the atom giving rise to the γ-radiation. This has been described by Ellis[1] as the internal photoelectric effect. For a long time, the obvious explanation has been that the γ-ray is sometimes absorbed by the extranuclear electron which is emitted with the energy given by the Einstein equation. Calculations based on this view, made recently by Casimir, lead to the conclusion that the probability of emission of the photoelectron is about 1/10 to 1/30 of that experimentally observed. Thus, for RaC γ-ray of energy 6.12×10^5 volts experiment shows that in 994 disintegrations out of 1000 the γ-ray escapes and in 6 it is absorbed. Therefore, the value for the probability of absorption is 6×10^{-3}, while the calculated value for this case is only 0.46×10^{-3}; that is, *the experiment shows the atom to possess about ten times more opacity for its γ-radiation than is indicated by calculation.*

The wave mechanics[2] does suggest, however, a different kind of energy transfer between the nucleus and the outer electron; that is, energy can pass directly from the nucleus to the electron without the intervening process of the emission of radiation in the nucleus and its absorption by the electron taking place. This may be called a radiationless energy transfer, and in fact the experimental results taken in conjunction with the calculations of Casimir indicate that such radiationless transfers are ten to thirty times more frequent than the radiational ones.

We now turn to the stellar structure.

The recent investigations of Prof. Milne[3] have led us to consider every star as made up of a degenerate core surrounded by a gaseous envelope. In the case of white dwarfs this gaseous envelope is negligible. The important question in connexion with the theories of stellar structure is that of opacity. The greatest difficulty of the theory of Eddington has been that it demands stellar opacities about ten times higher than can be allowed by physical considerations. It has been said[4] that Milne's theory only enhances this discrepancy.

The purpose of this note is to suggest that Milne's theory is capable, at least qualitatively, of overcoming this difficulty. In the degenerate core

because of the interaction between the electrons, there is a finite probability for the energy (and momentum) of an electron in one part of the core to pass directly to another electron in some other part of the core without the intervening process of radiation taking place; that is, in the degenerate core the transfer of energy mostly takes place by the radiationless process and this energy is then converted into radiation in the non-degenerate envelope surrounding the core. Because the energy is transferred by the radiationless process, the 'opacity' may be (as in the case of the radioactive atom) considerably higher than it would be if this transfer of energy took place in the form of radiation. *We may thus connect the discrepancy in stellar opacity to the same cause as that of the internal photoelectric effect in the atom.*

Another interesting point which may be mentioned is that of the emission of high speed electrons from the white dwarfs, which are almost completely degenerate, and hence the chances of collision for an escaping electron are very small. These high speed electrons *will in some cases have energies comparable to the cosmic radiation.* In fact, it can be easily seen that due to this electron escape a black dwarf will lose almost all of its mass—*the final state of a black dwarf is a diffuse mass.* These considerations will be published elsewhere in detail.

D. S. KOTHARI.

45 Belvoir Road, Cambridge,
April 19.

[1] Ellis: a very lucid account is given in *Science Progress*, April 31, p. 615.
[2] Fowler, *Proc. Roy. Soc.*, vol. 120, p. 1.
[3] Milne, *Mon. Not. Roy. Ast. Soc.*, vol. 91, p. 4.
[4] *Observatory*, Feb. 1931, p. 36.

Coherent Expanded Aerogels and Jellies

THE continuity of the liquid permeating jellies is demonstrated by diffusion, syneresis, and ultrafiltration, and the fact that the liquid may be replaced by other liquids of very diverse character indicates clearly that the gel structure may be independent of the liquid in which it is bathed. Hitherto the attempt to remove the liquid by evaporation has resulted in shrinkage so great that the effect upon the structure may be profound.

Mr. Charles Learned and I, with the kindly assistance and advice of Prof. J. W. McBain, undertook to test the hypothesis that the liquid in a jelly can be replaced by a gas with little or no shrinkage. Our efforts have met with complete success.

The procedure that we have adopted is as follows. The jelly is first formed in a suitable liquid in dilute form. The liquid is then replaced by another which does not dissolve the structure and has a reasonably low critical temperature. Alcohol has proved quite satisfactory for most of the inorganic gels, ether has advantages in the case of easily reduced substances, and propane was used for all of the organic jellies. In making the replacement, it is necessary that each liquid used be completely miscible with both that which precedes and that which follows it. For example, water may be replaced by alcohol and then by ether. Mere evaporation would inevitably cause shrinkage. However, the jelly is placed in a closed autoclave with an excess of liquid and the temperature is raised above the critical temperature of the liquid, while the pressure is maintained at all times at or above the vapour pressure, so that no evaporation of liquid can occur and consequently no contraction of the gel can be brought about by capillary forces at its surface.

When the critical temperature is passed, the liquid has been converted directly into a permanent gas without discontinuity. The jelly has had no way of 'knowing' that the liquid within its meshes has become a gas. All that remains is to allow the gas to escape, and there is left behind a coherent aerogel of unchanged volume.

Silica aerogel with a density so low as 0.1 is very easy to prepare, and we have prepared some with a density of only 0.02. The silica aerogels are highly opalescent, although quite transparent; they display a glassy fracture and small pieces emit a metallic ring when dropped.

So far, we have prepared silica, alumina, nickel tartrate, stannic oxide, tungstic oxide, gelatine, agar, nitrocellulose, cellulose, and egg albumin aerogels and see no reason why this list may not be extended indefinitely. Apart from the scientific significance of these observations, the new physical properties developed in the materials are of unusual interest.

S. S. KISTLER.

College of the Pacific, Stockton, and
Stanford University, California,
April 8.

Two Modifications of Liquid Nitrobenzene

THE changes of dielectric constant and density of liquid nitrobenzene with temperature, studied by one of us (J. M.) and described in communications to NATURE, suggest that at 9.5° the liquid undergoes an energy transformation analogous to that found for liquid helium by M. Wolfke and W. H. Keesom,[1] and for liquid ethyl ether by M. Wolfke and J. Mazur.[2]

To confirm this supposition we have made a study of the heating curve of carefully chemically purified nitrobenzene. Nitrobenzene cooled to a temperature lower than the point in question (6° C.) was contained in a Dewar vessel provided with a nickel-plated

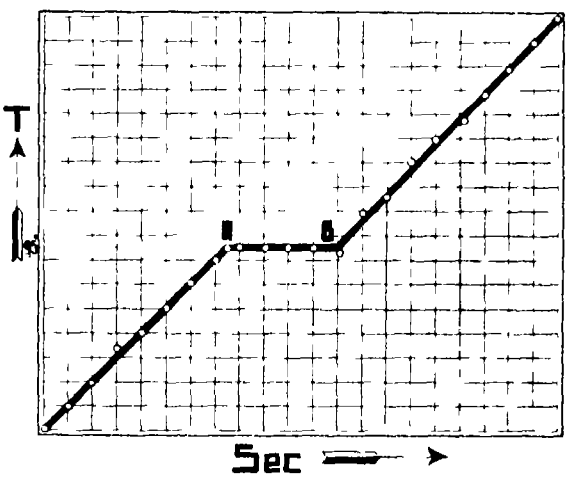


FIG. 1.

refrigerator. We have studied the change with time on gradually increasing the temperature of nitrobenzene which was isolated from all external disturbances.

The platinum resistance thermometer, calibrated with the aid of the standard thermometer of the Cryogenic Laboratory at Leyden, was used as a stirrer.

The experiments were repeated three times and they show that at 9.5° there is a distinct slowing down of the rate of change of temperature (see the part *A B* of the curve, Fig. 1). The parts of the curve above and below the point 9.5° are parallel straight lines, which

shows that the specific heat of nitrobenzene does not undergo a change at 9 5°

This phenomenon is a third case of appearance of a transformation point for two different modifications of a liquid

M WOLFKE
J MAZUR

Physical Laboratory,
Technical Institute, Warsaw, April 4

[1] Comm Leiden 1906

[2] NATURE 126 684, Nov 1 1930 C R Sci Soc Polon de Physique, 5, 3, 1931

Adsorption of Hydrogen on Charcoal

IN connexion with the recent development of the theory of activation of adsorption processes by H S Taylor (J A C S, 53, 578, 1931), it may be interesting to note that a 'Norite charcoal, which adsorbed practically no hydrogen at room temperatures, adsorbs hydrogen at increasing rates as the temperature is raised Thus, when 1 17 c c hydrogen were admitted to the charcoal at 395° C, the pressure fell from 0 514 cm to 0 076 cm after 9 hours, about 1 c c of gas being adsorbed At 340° C, with an admission of 1 19 c c, the pressure only fell from 0 572 cm to 0 251 cm in a similar period, showing a much smaller and slower adsorption of hydrogen than at 395° C At temperatures below 200° C the rate of adsorption is too slow to be measurable

F E T KINGMAN

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The Wall of the Cotton Hair

MEASUREMENTS of the dimensions of cross sections of cotton hairs have been obtained by us at Giza, in some preliminary studies for technological purposes, of different pure lines of Egyptian cotton On plotting correlation diagrams between the thickness of the cell wall and the 'ribbon width' (the maximum diameter of the collapsed cell tube) we have detected several facts which are of exceptional interest to plant physiology as well as to technology A characteristic diagram is here reproduced (Fig 1)

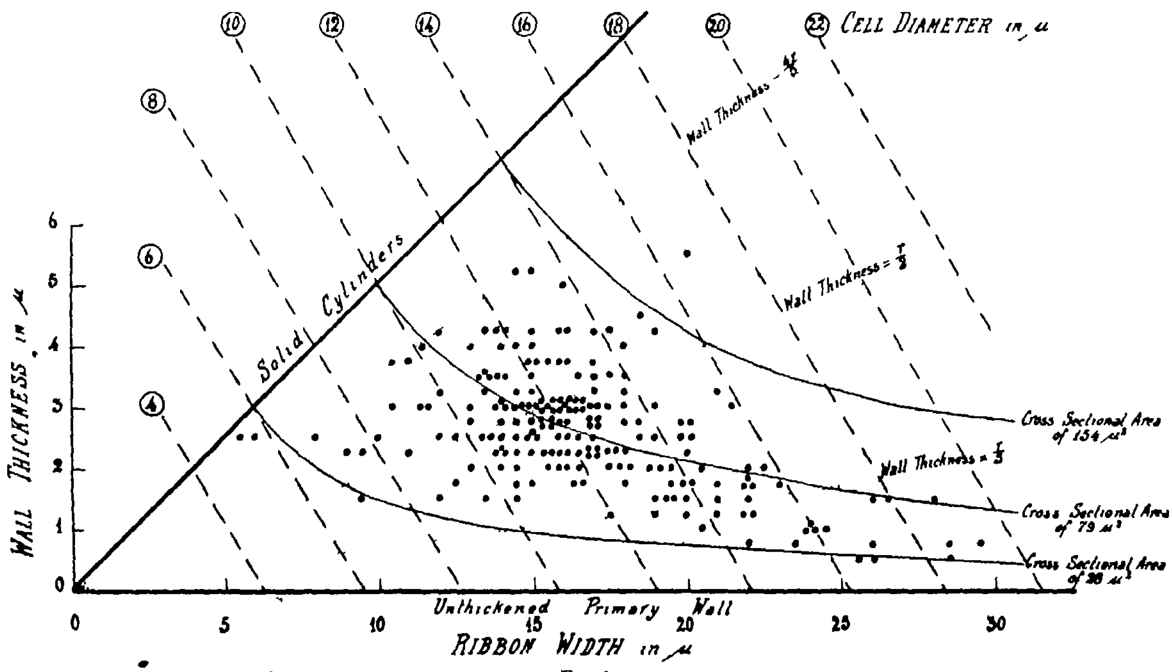

FIG 1

The nomograph lines drawn on this diagram are self explanatory, excepting perhaps those of equal cell diameter, which are the result of the fact that a fully thickened hair cannot collapse at all, so that its ribbon width is identical with the cell diameter, contrariwise, a very thin walled hair collapsed until its ribbon width is almost equal to half the circumference of the cell [1] Strictly speaking, these lines should not be straight, also there are small sources of error in measuring the ribbon width of very thin walled hairs, but we can disregard these minutiæ for the present purpose

The outstanding feature is that the correlation axis tends to follow the curved lines of equal cross sectional area Otherwise stated, the volume of cellulose forming material which enters each cell would be approximately constant if the cells were of equal length A strong cross checking observation has been formerly recorded by one of us [2] in the fact that variations of wall thickness during the whole fruiting season are not of linear dimensions, although the quantity measured is a linear one, but they are definitely of square dimensions, that is, areas This result is, however, not simply a matter of volume of cellulose, because the hair weight per centimetre is known to be nearly constant for all lengths of hair,[3] so that we cannot describe the wall thickness as being conditioned by the area of primary wall surface which has to be covered in spite of the fact that it is so conditioned by the perimeter of the tube This curious discrepancy may help to illuminate the mechanism of cellulose deposition [4]

Actually the diagram shows that in the cells of larger diameter the wall is even rather thinner than a strict adherence to constant area would suggest, the curvilinear correlation axis (not drawn) crosses the 79 μ^2 line

A problem of the cell wall as yet unsolved is whether thin walls have the normal number of growth-rings, or whether they are thin because only a few growth-rings have been deposited The form of the lower boundary of the group of dots (bounded as it is by the 28 μ^2 line) strongly suggests that every one of

the two hundred cells measured has undergone the full sequence of growth-ring deposition, otherwise there should be thin walls among the small diameter hairs

The form of the upper boundary, showing that a lumen the radius of which is about one fifth of the cell radius is normally left unfilled, is of physical interest, as will be seen presently

A result of technological importance, both to cotton spinner and cotton grower, relates to the question of 'nep' These hairs (which have walls so thin that they easily roll up into tangled bundles during their passage through the machines) are seen in this diagram to be predominant in the cells of big diameter, and to be absent among small diameter cells Formerly one had imagined that they would be found in all diameters

Lastly, we would point out that care should be taken in translating such data as these, drawn from the dead dry hair, into terms of growth and development We have found that the frequency diagram of cell diameter undergoes remarkable modifications according to the condition of the hairs when measured Living hairs measured from the green boll are much larger than the dead hairs, and these again are much larger than hairs 'swollen' with caustic soda to restore them to cylindricality, in Harland's method [5] But, whereas the shape of the frequency distribution is unchanged between the living hair and the soda treated hairs, the case is quite otherwise with the dry dead hairs, these have a far more compact distribution, and we have verified by direct search through our material that the thick walled small hairs actually enlarge their diameter when the irreversible loss of water takes place at death, their centre is in compression when alive, presumably through convergence of the space lattice columns of the fibrils towards the centre This inference is cross checked by Slater's unpublished observation, that the core of a cylindrical hair is more rigid than its periphery In the thin walled hairs, the removal of the water lost irreversibly after death allows the periphery to contract, the outer growth rings, primary wall, and cuticle are thus in a state of tension, which accounts for the fact that most cross sections of the dead cell have a crumpled appearance, unless the wall is more than half a radius in thickness On softening with caustic soda, this tension relieves itself and the diameter decreases still further, even in the thick walled small hairs

It is remarkable that the physical properties of the cellulose wall should result in presenting to the cotton spinner a much more uniform product than is produced on the plant, even though the plant has already done its best for him by making hairs of fairly uniform weight out of cells the diameter of which varies greatly Thus, in the present diagram, the range of cell diameter from 5 to 19 microns (μ) might be expected to entail a range of cross sectional area from 25 to 361 (being the squares of these diameters), whereas the actual area range is only from 25 μ^2 to 220 μ^2

C H BROWN
ABD EL GHAFFAR SELIM
W LAWRENCE BALLS
Ministry of Agriculture,
Botanical and Plant Breeding Section,
Gîza, Mar 22

[1] W L Balls, Development and Properties of Raw Cotton, London, 1915, p 143

[2] W L Balls, "Growth Fluctuations during the Development of Seed Cotton", *Tech Bull*, No 101 Min of Agric, Egypt

[3] W L. Balls, Studies of Quality in Cotton', London, 1928, p 154 Also Iyengar, R L N, and Turner, A J, The Weight per Inch of Fibres of different Lengths", Indian Cent. Cott Comm, *Tech Bull*, B, No 7

[4] Pierce, F T, "Mechanism of Growth in the Cotton Hair', *Trans Faraday Soc*, No 115, 26, part 12, 1930

[5] Calvert, M, and Harland, S C, An Approximation to the Original Cell Diameter", *Shirley Inst. Memoirs*, vol 2, No 29

Plankton Changes on the Coast of Ecuador.

I HOPE some oceanographer will be prompted to write at length some explanation (1) of the erratic behaviour of El Niño and (2) of the lenses of foul yellow water of which Mr G Sheppard writes in NATURE of April 25 May I make two suggestions ?

The coolness and fertility of the Humboldt water is due to the upwelling of water from the depths to replace surface water blown westward by the prevailing off shore winds of Peru and Chile In *Yachting* of March and April, I read that the sailing yacht *Carlsark*, in six weeks of a voyage across the Atlantic last year, in the trade wind belt had only one day of north east trades—and that, the first day out of Santa Cruz Might not the cause of El Niño overcoming the Humboldt be due to a similar failure of the south east trades over the Andes ?

Winter gales pile up sea wrack in the salens of Scotland's west coast Several such inlets have the appropriate place name of Brennfort (stinking port) With an off shore wind and a high spring tide, I have seen huge areas of this putrid weed carried out into the sound in summer time May I suggest, though unfamiliar with local physiography, that the prevailing in shore wind of the Bay of Panama chokes up lagoons with rotting sea ware, and that, concurrently with high tides, a reversal of the usual wind, for example, by the north east trades crossing the Isthmus, might carry out the stagnant water to join El Niño ?

I fear this is not a sufficient cause for the vast volume of putrid water that created such havoc among fish and birds off the Peruvian coast some six years ago I have heard that boats painted with white lead turned quite black That extensive miasma might have been due to volcanic action in the seas round the Galápagos

WILLIAM SEMPLE
Mile Ash, Dumfries,
April 27

MR G SHEPPARD's letter under this heading, in NATURE of April 25, directs attention to a matter which may be of serious importance Apparently, the fœtid plankton accumulations described were dead material Years ago, when oil began to be discharged upon the troubled waters of the oceans, some of us suggested *that the plankton might suffer* Since then, multitudes of birds have been cast dead upon our shores enwrapped in oil Occurring as these discoloured patches do, in the steamship lanes, they may be but a fulfilment of our prediction—one which sooner or later must come true we cannot for ever sin against Nature Has any attention been paid to such possibility by those who are studying the problem ? Forced by modern sanitary practice to send our phosphates to sea, it will be strange if revenge be taken, through the oil wasters who are everywhere fouling the ways of life through their interference with the recovery of phosphate by plankton

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The Mode of Action of Insulin

IN a consideration of the mode of action of insulin it is of some importance to know the equivalent relationship between the amounts of hormone and dextrose, that is, the number of molecules of dextrose equivalent to one molecule of insulin Up to a recent date this ratio was not known, on account of lack of knowledge of the molecular weight of insulin A recent communication to NATURE [1] from Prof The Svedberg has, however, provided the necessary information on this point The molecular weight of 35,100 deduced

by Prof Svedberg is in agreement with the physico chemical behaviour of insulin, and is of the same order as those of ovalbumin and Bence Jones protein

According to the extensive determinations of Culhane Marks, Scott, and Trevan,[2] one international unit of insulin is equivalent to 1/24 mgm of crystalline insulin The weight of dextrose which this amount of insulin will remove from the blood is provided by data from the standardisation of insulin by the fall of blood sugar in the rabbit Assuming that the blood of a rabbit averages 1/13 of the total weight the mean of the blood sugar decrease in 174 rabbits (starved for 24 hr), following injection of one unit of insulin, amounts to 100 mgm of dextrose In order to obtain this figure (for which I am indebted to the Pharmacological Department of these laboratories) the maximum drop of blood sugar level has been taken The true figure is probably higher, for although the decreased blood sugar level inhibits the physiological production of insulin, the resulting liver glycogenolysis would tend to prevent the minimum level being attained This glycogenolysis is subnormal in rabbits starved for 24 hours

The only other figure available in the literature is that due to Bouckaert *et al*,[3] who found that in order to maintain a normal blood sugar level in rabbits receiving parenterally 1 26 gm of dextrose per kgm per hour, the injection of 6 8 units of insulin per kgm per hour was necessary This indicates that one unit of insulin is equivalent to 185 mgm of dextrose I have taken a mean value of 150 mgm as the dextrose equivalent of one international unit of insulin Hence it follows that 1 gm of insulin will remove 3600 gm of dextrose, or using the value of 35,100 for the molecular weight of insulin, one molecule will remove $\frac{3600 \quad 35100}{180}$, or approximately seven hundred thousand molecules of dextrose Thus, there is no possibility that the action of insulin in removing dextrose from the organism is a stoichiometrical one depending on the presence of a number of certain active groups in the insulin molecule F O HOWITT

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[1] Mar 21 1931, 438
[2] *Biochem J* **23** 397 1927
[3] *Arch intern physiol* **31** 180 1929

Singlets of the Two-Electron Spectra B II, C III, N IV, and O V

IN a recent analysis of C III the absolute term values of singlets and triplets could be independently determined from the D series in both systems The difference $2\ ^1S_0 - 2\ ^3P_1$ was obtained as 52 380 ± 200 cm^{-1}, which conclusively proves that λ2297, ν43524 cannot be the intercombination line, proposed by Bowen and Millikan [1] Indeed, no such line has been found, in agreement with the improbability of a change of s in a spectrum with such small j separations

The strong C III lines λ2297 and 1247 are identified with transitions to the normal $2s\ 2p\ ^1P_1$ from the two deep terms $^1D_2$ and $^1S_0$, arising from the configuration $2p\ 2p$ The terms thus obtained are checked by a large number of combinations with higher singlet levels

In consequence of these identifications, the corresponding transitions in B II are taken as the lines λ3452 and 1842, previously thought [1] to be $2\ ^1S_0 - 2\ ^3P_1$ and $2\ ^1P_1 \quad 3\ ^1S_0$ Using the irregular doublet law, the combinations $2S - 2P$, $2P - 2D'$, and $2P - 2S'$ are then found for N IV and O V as shown in the accompanying tables Three of the tabulated lines, B II $2P - 3D$, B II $2S - 2P$, and C III $2S - 2P$, were given their right assignment by Bowen and Millikan [1] The terms are calculated from $2P - 3D$ on the assumption that

$$3D - Z^2 \times \frac{109{,}737}{3^2}\frac{1}{\ },$$

which was very closely verified for C III by 5 members of the D series The n^* for D' and S' are referred to the $2p$ state of C IV

	$2P \quad 3D$	$2s\ 2p\ ^1P_1$	$2S - 2P$	$2s\ 2s\ ^1S_0$
B II	72,519 1378	121,291 1 90	73,396 1362	194,687 1 50
C III	174,131 574	283,868 1 86	102,351 977	386 219 1 60
N IV	298 525 335	493,613 1 89	130,687 765	624,300 1 68
O V	453,819 220	758,644 1 90	158,795 629	917,439 1 73

	$2P - 2D$	$2p\ 2p\ ^1D_2$	$2P - 2S$	$2p\ 2p\ ^1S_0$
B II	28 966 3452	92 325 1 77	54 264 1842	67,027 1 95
C III	43 524 2297	240 344 1 80	80 168 1247	203 700 1 92
N IV	58 189 1724	435 424 1 85	104 676 955	388,937 1 93
O V	72 924 1371	685 720 1 87	129 112 774	629 532 1 94

In the next table, $3P$ is determined from $2S \quad 3P$, and then, confirming the term system strong lines are found in all the spectra at exactly the calculated position for $2D - 3P$ In C III, $2S' - 3P$ was also found

	$2S - 3P$	$2s\ 3p\ ^1P_1$	$2D - 3P$ calc	$2D - 3P$ obs
B II	144,105 693	50 582 2 95	41 743	41 740 2395
C III	258 941 386	127,278 2 79	113 056	113,056 884
N IV	404 524 247	219,776 2 83	215 648	215,652 463
O V	580,828 172	336,611 2 86	349,149	349,113 286

These transitions, $2p\ 2p\ ^1D_2 - 2s\ 3p\ ^1P_1$ and $2p\ 2p\ ^1S_0 - 2s\ 3p\ ^1P_1$, are in accord with the Heisenberg selection rule [2] for two electron jumps, $\Delta l_1 = \pm 1$, $\Delta l_2 = 0$ or $+2$ However, no trace has been found of the corresponding transition in the triplet system, $2p\ 2p\ ^3P - 2s\ 3p\ ^3P$, agreeing with another form, $\Delta l_1 = \pm 1$, $\Delta l_2 = \pm 2$, given as the Heisenberg rule by Grotrian [3] and Pauling and Goudsmit [4] It seems as if the observed data in C III could be represented by the addition to the selection rule that the transitions $\Delta l_1 = \pm 1$, $\Delta l_2 = 0$ are allowed only if $\Delta L = \pm 1$

BENGT EDLÉN

Physics Laboratory, University,
Uppsala, April 10

[1] I S Bowen and R A Millikan, *Phys Rev*, **26**, 310 , 1925
[2] W Heisenberg *Zeit f Phys* **32** 841 , 1925
[3] W Grotrian Graphische Darstellung der Spektren, etc I p 204, 1928
[4] L Pauling and S Goudsmit The Structure of Line Spectra , p 93 1930

Modern Progress in Vertebrate Palæontology *

By Sir ARTHUR SMITH WOODWARD, F R S

IN a paper read to the Zoological Society in 1880, Huxley remarked that the astronomer who had determined three places of a new planet could calculate its place at any epoch, however remote, and if the law of evolution was to be depended upon, the zoologist who knew a certain length of the course of that evolution in any given case, might with equal justice reason backwards to the earlier but unknown stages He accordingly surveyed the back-boned or vertebrate animals both living and extinct, so far as they had then been discovered, and he defined the successive stages through which they must have passed before they ended in the higher warm blooded quadrupeds and birds which dominate the world of life to day He pointed out how, in the existing world, most of the earlier stages are represented only by animals with very special adaptations to their several modes of life, which give little idea of the variety displayed by animals of the same stage in former geological periods He concluded that a multitude of extinct groups of each stage had still to be revealed, most of those groups being short lived adaptations to the several spheres of life which were open to them at the time, and only a small proportion on the direct line of ancestry of the existing vertebrate animals The actual links in the chain of life from the lowest to the highest rank must, therefore, have been comparatively few

Even in Huxley's time there were already indications of several more extinct groups than those he dealt with in his researches, but the fossils by which they were known were too fragmentary to be satisfactorily interpreted During more recent years, those early discoveries have been supplemented by numerous collections from various parts of the world, while the methods of preparing and studying even the most unpromising fossils have in all respects greatly improved Much progress has, therefore, been made in understanding the relationships of the extinct forms of life, and in using them for discussing the problems of organic evolution The vertebrates, especially, have proved remarkably interesting

The earliest forerunners of the vertebrate animals (the Hypichthyes of Huxley) have not yet been found among fossils, probably because they had no hard parts capable of being preserved in ordinary circumstances in rock They are still known only by their highly modified living representative, *Amphioxus* Huxley's second stage, however, that of the Myzichthyes, represented by the lampreys and hag-fishes at the present day, has now been identified among fossils exactly where it might have been expected It flourished especially in the latter part of the Silurian period, but ranged from the Ordovician to the Devonian It included free-swimmers like the Anaspida, which have been found well preserved in the Upper Silurian (Downtonian) rocks of southern Norway and southern Scotland They had an external skeleton enough to show that, while they agreed with the lampreys in the single narial opening and in the pouched gills, they had less degenerate jaws and possessed incipient paired pectoral fins They also resembled the larva of the existing lamprey in having the end of the body turned downwards into the tail fin They were accompanied by other Myzichthyes, like the Cephalaspidians, which were bottom dwellers and had both an external skeleton and an internal head skeleton so well ossified that in specimens discovered in Spitsbergen, Prof Erik A Stensio, of Stockholm, has been able to recognise many of their lamprey like characters The surviving lampreys and hag-fishes, therefore, give no idea of the variety and adaptations of the Myzichthyes in their prime, when they dominated the world of life

The next stage, that of the Chondrichthyes, represented by the existing sharks, skates, and chimæroids, has also lately been recognised as dominant in its proper place in the geological record Thanks especially to the researches of Stensio, it now seems clear that during the latest part of the Silurian period and the Devonian period, when these fishes were in the forefront of progress, they developed true bone both externally and internally They included the free swimming Acanthodians, which are very shark like, but have long been puzzling because, although their skeleton does not consist of typical bone, it is of more complex structure than the hard tissue of any modern shark or skate The Chondrichthyes also included the heavily armoured grovelling fishes like *Coccosteus* and *Dinichthys*, which are now generally known as *Arthrodira* Quite lately, Prof F Broili has described a skate-shaped fish, *Gemuendina*, from the Lower Devonian of Germany, which seems to combine the characters of an Arthrodiran with those of a skate Also, not long ago, Prof P Pruvost found, in the Lower Carboniferous of Belgium, part of a peculiar shark, *Cratoselache*, which retains the remnants of the bones of an Arthrodiran in the roof of its skull

Huxley's next stage in the evolution of the vertebrates, that of the Herpetichthyes, or fishes which gave rise to the lung-breathers as well as to the typical modern fishes, proves to be represented among fossils not precisely as he supposed it to be The Dipnoi, which he thought were the ancestral lung breathers, seem now to be merely an offshoot which ended in the existing *Lepidosiren*, *Protopterus*, and *Ceratodus* The real links between the Herpetichthyes and the earliest lung-breathers or Amphibia are the osteolepid fishes, which begin just where they might be expected, in the Middle Devonian rocks

The Amphibian stage occupied the foremost place in the world of life of the Carboniferous period, and

* From the Huxley Lecture delivered in the Imperial College of Science on May 4

Prof D M S Watson has shown that some of its representatives during this period, the early stegocephalians, are remarkable links between the osteolepid fishes and the later amphibians

The next or Hypotherian stage, which flourished in the Permian and Triassic periods, included the ancestors of the mammals besides those of the reptiles and birds Huxley did not recognise the former, but since 1880 the discoveries of Seeley, Watson, Haughton, and especially Broom, in South Africa, have revealed skeletons of cynodonts which can scarcely be distinguished from those of primitive mammals In general appearance the skull always resembles that of a carnivorous mammal, and the teeth are arranged as if they were incisors, canines, premolars, and molars The teeth also differ from those of ordinary reptiles in having scarcely any replacing teeth Still more remarkable is the lower jaw, which consists almost entirely of the pair of dentary bones, as in a mammal, the other bones being reduced to a little cluster behind where they articulate in the reptilian way with the quadrate bone of the skull In some of the little cynodonts which are no larger than rats (Ictidosauria), the quadrate bone is so small that it forms only part of the articulation for the lower jaw, the rest being formed by the squamosal bone, which extends to the whole of it in mammals Through the cotylosaurian reptiles there are indications of every gradation between these cynodonts and the earlier amphibians, so that satisfactory links between the lowest and the highest land vertebrates will probably soon be forthcoming

It is especially interesting to note that the nearest approach of the hypotherian stage to the next higher or prototherian stage is made by species of comparatively small size, for when undoubted Prototheria first appear later in the Jurassic rocks, scarcely any of them are larger than rats When the first known representatives of the next higher mammalian stages of Metatheria and Eutheria follow them in the Upper Cretaceous rocks, the species are of equally small size So far as palæontologists have experience at present, all links between the greater groups of vertebrate animals are to be found among the smallest, not the largest species

Owing to the fragmentary nature of the fossils, little can be said about the Prototheria, which are represented in the existing world only by the monotremes of the Australian region During the Jurassic and Cretaceous periods, they were overshadowed by the reptiles which flourished everywhere, and they seem always to have occupied a subordinate position Very little is known also of the earliest Metatheria and Eutheria, which are represented at the present day by the marsupials and the higher (placental) mammals respectively They appear together in the Upper Cretaceous formations of western North America, and skulls of small Eutherians have lately been found by an American expedition in corresponding rocks in Mongolia. It is clear, however, that by the beginning of the succeeding Tertiary period, which has well been named 'The Age of Mammals', the chief groups of Eutherians were already diverging into the several lines which have eventually become more clearly separated and even again subdivided In certain paragraphs of his classic paper of 1880, Huxley distinctly recognised these facts and briefly stated them It is, therefore, curious that he used parallel lines instead of diverging lines to represent the hypothetical pedigrees in his "Table of the Arrangement of the Mammalia", which has accordingly been criticised with some justification

Huxley's interest in the subject was first roused by the numerous discoveries of ancestral mammals which were being made in the 'seventies in the Tertiary land deposits of western America, and especially by his visit to Prof O C Marsh in 1876, when he examined the great collection of fossils in the Museum of Yale University at New Haven At this time, Prof Marsh had just arranged a series of specimens to show the genealogy of the horses, beginning with little four toed swamp animals which had low intelligence and crushing teeth, and ending in the largest one toed, plain roaming animals, which had a much superior brain and grinding teeth Subsequent more elaborate collecting and research in the same rocks by Prof H F Osborn and his colleagues, of New York, have shown that the gradual evolution of the horses can sometimes be followed even in the most minute characters At the same time, they have proved that the tracing of genealogies among the fossil mammals is not so easy as was at first supposed, even when the specimens are numerous and display well-preserved important features It now appears that in each group there is no single line of advance, but there are several lines all changing in the same direction, only with slight differences and often at different rates These are generally assemblages adapted for somewhat different modes of life Such parallel developments have been observed in America among the fossil rhinoceroses, camels, cats, and other groups, and they are especially evident in the extinct hoofed animals known as the Titanotheres, which have lately been described by Prof H F Osborn in the most exhaustive treatise ever devoted to a group of fossil vertebrates There can, indeed, no longer be any doubt that each great group starts its career in geological time with certain innate potentialities which we do not understand, but which compel all its members, however varied may be their respective adaptations and modes of life, to follow the same course to the end

In the Old World, we have had fewer opportunities of following the evolution of the Eutherian mammals, because the fossil record has so far proved much more incomplete Among achievements during this century, however, must be specially mentioned the discovery by the late Dr Charles W Andrews of the pedigree of the elephants Even in this case, we now realise that some remarkable changes occurred independently in more than one line Among the later elephants, at any rate, there must have been several parallel series evolving in the same direction

The Old World, nevertheless, has its compensations, for here we are able to study the most fascinat

ing problem of all among mammals, the ancestry of man himself There can now be no doubt that the man-like apes have always been restricted to the Old World, and that the ancestors of man must be sought among their ancestors Hitherto, we have not made much progress, but the few discoveries that have rewarded our efforts during the present century are decidedly encouraging In Huxley's time, the only fossil man known which exhibited more resemblances to the ape than any existing man, was that of the race first met with in 1856 in a cave in the Neanderthal, near Düsseldorf, Germany His skull resembled that of the apes in its great bony brow-ridges, and his lower jaw lacked the usual prominence at the bottom of the bony chin Among subsequent discoveries, the fragment of skull of *Pithecanthropus* from Java has still more prominent brow-ridges, and a human lower jaw from Heidelberg has a still more ape like bony chin On the other hand, the equally ancient skull of *Eoanthropus* from Piltdown, Sussex, has a good forehead without brow ridges, and it approaches apes chiefly in its remarkable lower jaw and teeth Now we welcome the recent discoveries of skulls and teeth of another fossil man, *Sinanthropus*, which have been made in a cave not far from Peking, in China These fossils date back to a geological period at least as remote as those of *Pithecanthropus*, *Eoanthropus*, and the Heidelberg man, and it is not impossible that they are more ancient They are, therefore, of extreme interest, and Dr Davidson Black's preliminary descriptions and beautiful photographs of them show that they are specially important as displaying in combination several characters which in previous specimens have been separate and distinctive In top view, for example, the skull of *Sinanthropus* looks astonishingly like that of *Pithecanthropus*, with the same bony brow-ridges, but the frontal region and parietal bosses are more tumid, and the bone is much thicker The brain-case is as thick as that of *Eoanthropus*, and the bone has the remarkably fine spongy texture which has previously been observed only in the Piltdown fossil The skull of *Sinanthropus* is also low and squat, with the same broad base and peculiarly-shaped occiput as in *Eoanthropus* It also has the modern-looking deep sockets for the articulation of the lower jaw The lower jaw and teeth of *Sinanthropus*, however, are more like those of Heidelberg man This combination is indeed curious, and each new discovery makes it more clear that modern man is the sole and successful survivor of many and very varied former approaches to the unique position which he now holds

In conclusion, the question arises as to whether such modern advances as have been described here, in the study of fossil vertebrate animals, are definitely leading to a better understanding of the general principles of our science We may reply that the progress already achieved has, indeed, been helpful in this respect, and that it is now much easier to predict lineages and the course of discovery than it was in 1880, when Huxley ventured on his pioneer essay We have made distinct progress in correlating changes in the world of life with alterations in surrounding conditions, and we can often trace gradual improvement in adaptation to controlling circumstances

It seems possible to recognise now even that the few fundamental advances in the evolution of the vertebrates have all coincided with widely spread "revolutions of the globe", to adopt Cuvier's old expression, which we may now use in a new sense The passage of the Myzichthyes into the Chondrichthyes seems to have occurred when fishes first ventured from the shallows into the open ocean The Herpetichthyes probably began in adaptation to the conditions of the fresh-water lakes, in the deposits of which we first find them During the Devonian period, when this adaptation was complete, the rocks show that there was widely spread desiccation in many parts of the world Conditions were, therefore, favourable for the origin of the amphibia, which seem to have appeared at about this time In the Permo-Triassic period there were again most extensive deserts, and the speculation has been hazarded that the reptiles, which had then become established, were stimulated to activity and evolution by the need for long journeys in search of food Some of the earliest reptiles, or Hypotheria, passed into the Prototherian mammals when genial conditions were advancing The Metatherian and Eutherian mammals first began to spread and take the place of the vanished dominant reptiles at the end of the Cretaceous period, when there were world disturbances in mountain building and a cooling of the climate in large areas of the northern hemisphere Finally, man emerged from the ape grade probably in the northern hemisphere during the hard circumstances at the beginning of the Great Ice Age in the Pleistocene period

Direct competition between the representatives of one stage and the next seems rarely to have happened The giant land reptiles, for example, which dominated the world during the Jurassic and Cretaceous periods, can scarcely have been exterminated by the competition of the mammals, which were all very small and scarcely came in contact with them The mammals spread and flourished only when the lands had become practically vacant, and long after the reptiles had disappeared, even so late as the Lower Eocene period, there were still no land animals of any kind larger than a pig Similarly, the great sea reptiles which lived until the end of the Cretaceous period, were not exterminated by the whales which eventually took their place We now know that the whales originated only after the ichthyosaurs, plesiosaurs, and mosasaurs had vanished, and that even the comparatively small ancestors of the whales never entered into competition with these forerunners in their sphere in the oceans

It is, indeed, probable that the procession of life which we observe has depended as much on the influence of surrounding conditions as on the inherent characters and tendencies of the various groups of organisms themselves For a further understanding of the subject, therefore, geologists and biologists must still continue to co-operate

Engineering Research in Great Britain

JAMES FORREST, who died on March 2, 1917, at the age of ninety one years, was connected with the Institution of Civil Engineers for fifty-four years, during forty of which he was assistant secretary or secretary It was the ambition of his life to make the Institution the premier professional society in the world, and during his tenure of the secretaryship the names on the roll of the Institution rose from between 800 and 900 to 6900, and the annual income from £3000 to £20,000 He retired from office in 1896, but six years previously the Council, to mark its appreciation of his work, presented his portrait to the Institution, and a little later the members placed at his disposal a sum of £500 Forrest himself determined that this should be devoted to the establishment of a James Forrest lectureship, to be administered by the governing body of the Institution and in 1893, Sir William Anderson was chosen to deliver the first lecture in accordance with the trust

Anderson's lecture was on the Interdependence of Abstract Science and Engineering ' Another lecture, given in 1896, was by Sir Alexander Kennedy, whose subject was ' Physical Experiment in Relation to Engineering

While these subjects gave a wide field over which the lecturer could roam at will, other lectures have been devoted to some specific branch of engineering, as, for example, the lecture on ' Unsolved Problems in Metallurgy ', delivered by Sir Robert Hadfield in 1906, and that on ' Unsolved Problems in the Design and Propulsion of Ships ', given by Dr Francis Elgar in 1907 but throughout the entire series of lectures research has been given great prominence, and in the opening of the thirty seventh James Forrest lecture, delivered at the Institution of Civil Engineers on May 5 of this year, Sir Thomas Stanton stated that his immediate object was ' to trace the changes which have taken place in the nature of the subjects studied in engineering laboratories from the date of Sir Alexander Kennedy's lecture in 1896 to the present time "

Forty years ago almost all engineering laboratories were attached to educational establishments and were simply physical laboratories modified for engineering purposes Problems of engineering research, however, became of a more ' physical ' nature, and in consequence engineering laboratory methods had to some extent changed their character, while engineering laboratory research is becoming more and more detached from engineering education

The matters discussed by Sir Alexander Kennedy were concerned almost entirely with the performance, economy, and efficiency of machines and prime movers work admirably adapted to meet the urgent educational need of that time, but the scope of modern investigatory work in engineering can be illustrated by a review of problems of interest studied recently at the National Physical Laboratory The work of the Engineering Department of the Laboratory can be divided into three groups (a) Government research done for research committees and boards of the Department of Scientific and Industrial Research, for certain research associations, for the Air Ministry, the War Office, the Ministry of Transport, and other Government civil departments (b) researches forming part of the general programme of the Laboratory Research Committee and (c) special investigations for the general public The latter work is undertaken at a scale of fees determined by the measure of publicity which clients are willing to allow to the Laboratory report Under group (b) were included in 1929 investigations of the efficiency of power transmission by gears, of hardness tests of materials, of stress distribution in reinforced concrete columns due to shrinkage, of the properties of waves set up by wind blowing over water, of vortex rings discharged in the wake of a disc immersed in a stream of fluid, and of the variation of pressure in steel cylinders containing dissolved acetylene as the temperature is raised

No fewer than twenty four subjects were included in the Government research programme in 1929, among these being investigations on lubrication, the transmission of heat, the ignition of gases by sudden compression, the fatigue phenomena exhibited by single crystals of metals, the bearings of aircraft engines, the endurance of laminated springs as found in motor vehicles, the mechanical properties of materials at high temperature, the resistance of projectiles, the pin joints of caterpillar tractor track shoes, the efficiency of motor lorry gear boxes, the distribution of wind pressure on roofs, the mixing and laying of concrete roads, and the friction of road surfaces Special investigations carried out in 1929 dealt with ceiling fans, steam pipe coverings, safety glass, brake linings, ball and roller bearings, the vibration of buildings, and the action between white metal alloys and lubricants

One piece of work of a novel and interesting character has arisen out of a visit to Paris in 1918 by the British Ballistic Mission, who saw there apparatus in which a model projectile was exposed to a momentary jet of air at high speed At the National Physical Laboratory it was found that the construction of a continuously flowing current of air up to twice the speed of sound presents far fewer difficulties than those experienced with the momentary jet, and a three-inch diameter wind channel has been developed in which the head resistance of model projectiles can be measured at speeds up to three times that of sound, and relative values due to changes in the design of the head and base of the projectile can be determined

One of the most striking developments of recent years is the increase in the application of the method of scale model testing to the solution of engineer-

ing problems The method was foreshadowed by Newton in the "Principia", and the theory was extended by Stokes, Helmholtz, Froude, James Thomson, and Osborne Reynolds The foundations of the method were laid by these pioneers, and the last forty years has witnessed the continued growth of its application to a wide range of problems Sir Thomas Stanton stated that he did not intend to put forward arguments for their extension, he believed that what is wanted is a somewhat more critical review than has hitherto been attempted of the implications of the method and of the extent to which engineers may rely on the predictions to full scale made from them He dealt with the principle involved in scale model testing, and illustrated it by reference to the prediction of the resistance of a ship, the hydraulic resistance of pipe lines, and the prediction of the wind resistance of roofs and bridges

The concluding part of the lecture contained a review of the present position of engineering research in Great Britain Sir Richard Glazebrook, in his James Forrest Lecture in 1923, reviewed then the conditions, and the most notable step taken since has been the formation of an important Research Department of the Ministry of Transport under the Roads Improvement Act, 1925, and the inauguration in 1930 of a research station at Harmondsworth This will probably be the largest engineering research laboratory in Great Britain There remains the important consideration of whether the financial provision for engineering research is adequate A comparison of Great Britain with other European countries is difficult on account of the lack of definite information, but a comparison with the expenditure on research in the United States shows that the sum we spend is of very modest proportions Research, however, is being encouraged in various ways and Sir Thomas Stanton said, "taking into consideration the sympathetic attitude of the Research Department, we may, I think, conclude that, apart perhaps from research in aeronautics and metallurgy, the existing provision for general engineering work is adequate, and that should further provision be considered advisable for investigations of national importance, the Department may be relied upon to give all the help that can be made available"

The Royal Institution

THE president, Lord Eustace Percy, and Managers of the Royal Institution went direct to the core of old English custom when they invited the members and other visitors, representative of the diplomatic and public services, science, arts, literature, and medicine, to a "House Warming" in Albemarle Street It was held on May 6, and was largely attended Fleetwood, in an epistolary of 1577, says, "The shoemakers of London having builded a newe Hall, made a royall feast for theire friends, which they call theire house warming" Then, Evelyn chronicles, under date Nov 28, 1661, "I dined at Chiffinch's house warming in St James's Park", and in a number of the *Spectator* for 1712, the following occurs 'I must make the present entertainment like a treat at an house warming, out of such presents as have been sent me by my guests"

The primary object of the house warming was, of course, to demonstrate the realisation in material form of the reconstruction effected in the Royal Institution It has long been recognised that rebuilding and a readjustment of certain parts to modern needs was a real necessity This applied particularly to the Lecture Theatre, which remained much as it was since completion in 1802, an auditorium, moreover, constructed entirely of timber We think that the Managers are to be congratulated on preserving so much of the old time atmosphere of this historic room, the scene of the early experiments of Davy and Faraday and their successors The scientific equipment of the theatre has now been considerably extended a cinematograph projector and an epidiascope have been installed, together with many technical desiderata essential for the proper and convenient elucidation of lecture subjects

FIG 1—New Entrance Hall, Royal Institution

The rebuilding of the Lecture Theatre has

naturally involved the replanning and reconstruction of a large adjacent part of the building The ante room on the first floor has been enlarged and redecorated in excellent taste Opening from this is the ambulatory, around which, beneath the seating of the theatre, well-lighted showcases for historic apparatus in the possession of the Institution have been arranged Opening from the opposite side of the ante room is a long corridor giving access to the Far Library and also to the Davy Faraday Research Laboratory

A new entrance hall has been constructed, and this is supplementary to the fine old entrance hall, and staircase, adjacent which was in existence in 1799 at the foundation and occupancy of the building A large new chemical laboratory has been built on the ground floor, and some of the rooms replanned, to enable an exit from the Lecture Theatre direct to the street to be made The basement area has been rearranged, and contains the workshops, the equipment for the distribution of electric power throughout all parts, and the heating and ventilation plant The new heating system in operation is entirely electric

An interesting programme was arranged for the house warming All parts of the Institution were open to guests, including the director's flat on the second floor, which contains Faraday's study Sir William Bragg gave demonstrations in the Lecture Theatre, comprehended in the title "Classical Experiments of the Royal Institution' He showed Davy's experiments on the decomposition by electrolysis of potash to obtain metallic potassium Faraday's experiment on the induction of electric currents in a coil by the movement of a magnet into and out of it was shown, his 'great cube' experiment, to show that electricity resides on the outside of a conductor, was also demonstrated, for which purpose a small wire cage was erected in the Lecture Theatre This experiment must have been described in hundreds of text-books, but there are probably not many who have seen a person sitting unharmed inside an electrified cage while sparks are drawn from the outside Rayleigh's experiment on the production of a sound shadow was also shown, the sound waves from a bird call were obstructed by a glass disc, on the other side of which a sensitive flame gave a response only when on the axis of the disc, due to a diffraction effect of the sound waves In relation to Sir James Dewar's low temperature work, a diamond was heated in a crucible and thrown into a dish of liquid air, where it burnt, deriving oxygen for combustion from the liquid air The historical apparatus in the keeping of the Institution was displayed and supplied with full descriptive particulars In addition, there were exhibits and experiments in the Davy Faraday Research Laboratory illustrating the latest developments in the technique of X-ray crystal analysis, these included a demonstration of the rotating cathode X ray tube developed by Dr A Muller

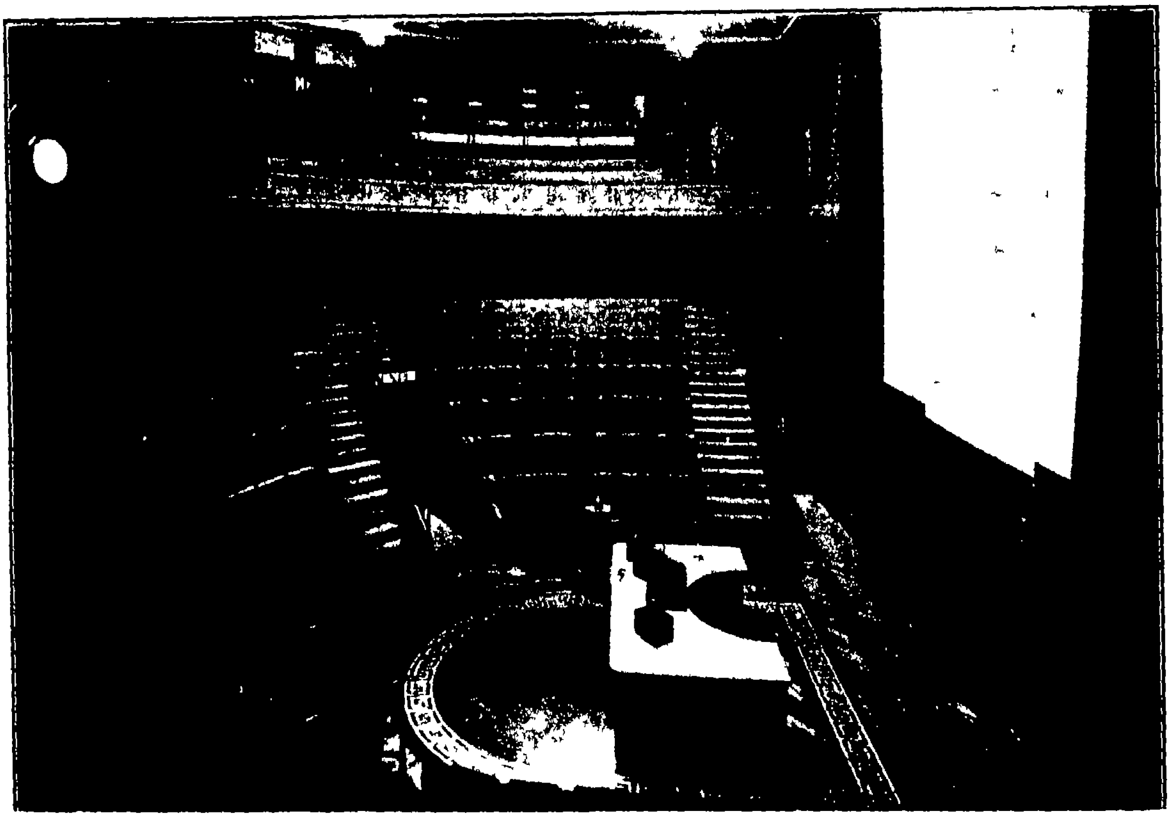

FIG 2 Lecture Theatre Royal Institution

Obituary

PROF A A MICHELSON, FOR MEM R S

WE much regret to announce the death, which occurred on May 9, of Prof A A Michelson, the distinguished physicist of the University of Chicago Prof Michelson was probably best known for his wonderful experimental work to detect any effect of the earth's rotation on the velocity of light At the end of 1929, he resigned his position at the University of Chicago and went to Pasadena, where he proposed to carry out further work on this subject, and it is reported that preliminary measurements have already been made Prof Michelson had worked previously at Mount Wilson Observatory, Pasadena, and a brief account of repetitions of the famous Michelson Morley experiment, as it is generally called, with a diagram of the apparatus, was contributed to NATURE of Jan 19, 1929, by him and his collaborators The results then obtained showed no displacement of the interferometer fringes so great as one fifteenth of that to be expected on the supposition of an effect due to a motion of the solar system of three hundred kilometres per second through the ether Since then, Prof Michelson has been awarded the Duddell Medal for 1929 of the Physical Society of London for his work on interferometry

In NATURE of Jan 2, 1926, we were fortunate in being able to publish, as one of our series of "Scientific Worthies", an appreciation of Prof Michelson and his work by Sir Oliver Lodge We print below extracts from that article

"Albert Abraham Michelson was born in Strelno, Poland, on Dec 19, 1852 In 1854 his parents migrated to the United States After emerging from High School in San Francisco, young Michelson was appointed to the Naval Academy, from which he graduated in 1873, and two years later became instructor in physics and chemistry under Admiral Sampson, continuing this work until 1879 After a year in the Nautical Almanac Office at Washington, Michelson, now an ensign, went abroad for further study at the Universities of Berlin and Heidelberg, and at the Collège de France and the École Polytechnique in Paris Upon his return to the United States in 1883 he became professor of physics in the Case School of Applied Science, Cleveland, Ohio, whence, after six years, he was called to Clark University, where he remained as professor until 1892, when the University of Chicago opened its doors Prof Michelson went to this new institution as professor of physics and head of the department In June 1925 he was honoured by being appointed to the first of the Distinguished Service Professorships made possible by the new development programme of the University

"It was while he was at Cleveland that Prof Michelson collaborated with Prof Morley in their joint experiment, and it may have been for the purpose of that experiment that he invented his particular form of interferometer, with the to and-fro beams at right angles Later, he applied it in Paris to the determination of the metre, with an estimated accuracy of about one part in two million

"During the War, Prof Michelson re entered the Naval Service with the rank of Lieutenant-Commander, giving his entire time to seeking new devices for naval use, especially a range-finder, which became part of the U S Navy Equipment

"A Nobel Prize was awarded to Prof Michelson in 1907, the first American to get one for science, and the Copley Medal, the most distinguished honour of the Royal Society of London, was awarded him in the same year

"The gold medal of the Royal Astronomical Society was presented to Prof Michelson on Feb 9, 1923, and the compact exposition of the reasons for that award, by the president, Prof Eddington, on that occasion will be found in NATURE, vol 111, p 240

"Michelson touched on many departments of physics, but in optics, the highest optics, he excelled In this subject he can be regarded as the most fertile and brilliant disciple of the late Lord Rayleigh, for his inventions are based on a thorough assimilation of the principles of diffraction, interference, and resolving power, and his great practical achievements are the outcome of this knowledge Michelson seemed to have a special instinct for all phenomena connected with the interference of light, with a taste for exact measurement surpassed by none in this particular region The interferometer with which he began became in his hands much more than an interferometer He applied it to the determination of the standard metre in terms of the wave length of light, with exact results which will enable remote posterity millions of years hence to reconstruct, if they want to, the standard measures in vogue at this day He applied it also to analyse the complex structure of spectrum lines, and with remarkable completeness to determine the shape and size of invisible objects, such as to ordinary vision, however much aided by telescopic power, will probably remain mere points of light

"In a magnificent paper in the *Phil Mag* of July 1890, Michelson suggested the application of interference methods to astronomy He knew well that the resolving power of a telescope depended on the diameter of its aperture, and that the formation of an image was essentially an interference phenomenon, the minuteness of a point image, and therefore the clearness of definition, depending on the size of the object glass But he pointed out that if the aperture was limited to slits at opposite edges—so that no actual image anything like the object would be formed, but only the interference bands which the beams from the two slits could produce—a study of those bands would enable us to infer about the source of light very much more than we could get by looking at its image For example, suppose it was a close double star, and suppose the slits over the object glass were movable,

so that they could be approached nearer together, or separated the whole distance of the aperture apart A gradual separation of the slits would now cause the fringes to go through periods of visibility and invisibility, and the first disappearance of the fringes would tell us that the distance apart of the two components of the star (multiplied by the distance between the slits and divided by the distance of the star) would equal half a wave length of light The two components might be far too near together ever to be seen separately, and yet we could infer that the star was a double one, and by further attention to the visibility curve we could infer the relative brightness of the two components and their position relative to our line of sight

Furthermore, if, instead of looking at a star, we turned the slit provided telescope on a planet with a disc too small for ordinary measurement, the size of that disc could be estimated from the behaviour of the interference fringes produced by its light in a suitable interferometer, or by the telescope converted into one

In view of the great interest aroused by the application of this method by Michelson himself, with the aid of collaborators at Mount Wilson Observatory Pasadena, California, and with the hundred inch telescope established there, it may be interesting to quote here part of the conclusion of his paper of date 1890

' '(1) Interference phenomena produced under appropriate conditions from light emanating from a source of finite magnitude become indistinct as the size increases, finally vanishing when the angle subtended by the source is equal to the smallest angle which an equivalent telescope can resolve, multiplied by a constant factor depending on the shape and distribution of light in the source and on the order of the disappearance

" '(2) The vanishing of the fringes can ordinarily be determined with such accuracy that single readings give results from fifty to one hundred times as accurate as can be obtained with a telescope of equal aperture '

' If among the nearer fixed stars there is any as large as our sun, it would subtend an angle of about one hundredth of a second of arc and the corresponding distance required to observe this small angle is ten metres, a distance which, while utterly out of question as regards the diameter of a telescope objective is still perfectly feasible with a refractometer There is, however, no inherent improbability of stars presenting a much larger angle than this and the possibility of gaining some positive knowledge of the real size of these distant luminaries would more than repay the time, care, and patience which it would be necessary to bestow on such a work '

' There seemed little hope at that time, and certainly no reasoned expectation, that any stars except perhaps some of the very nearest, could have discs big enough for perception and measurement even by this virtual telescope of thirty feet aperture The possibility of giant stars came, however, above our mental horizon, and Eddington made the notable prediction that a star like Betelgeuse must be in a highly rarefied state at a tremendously high temperature, and that it would be swollen out by the pressure of light to a size almost comparable with the dimensions of a solar system, although it could not contain very much more matter than, say, two or five times our sun His argument, in brief, is that the spectrum of a young red star like Betelgeuse shows that it cannot be radiating furiously Why then is it so conspicuous an object to our vision? It can only be because it is of enormous size, its density perhaps a thousand times less than atmospheric air By utilisation of the data available in the light of his theory of stellar constitution, Eddington made an estimate of the diameter of the star

'So with great skill Michelson and his collaborators got the interferometer to work After many preliminary adjustments, on Dec 13, 1920, Dr F G Pease at Mount Wilson, with Michelson's apparatus, measured the diameter of a star for the first time, using Betelgeuse for the purpose The interference fringes formed by the star were observed, the object mirrors were gradually separated, and it must have been a joyful moment when, as they grew farther and farther and farther apart, the fringes at the eye end became less distinct and ultimately disappeared The distance apart of the mirrors now, multiplied by the proper fraction, gave the angular dimensions of the star—a thing which had never before been observed in the history of the world An estimate of the star's distance gave its actual diameter, and confirmed Eddington's prediction!

Other stars have since been measured, and the giant stars well deserve their name Moreover, an instrument has been put in the hands of posterity to the power of which we can scarcely set a limit in investigating utterly invisible details, both about the heavenly bodies and about atoms, by the new and powerful method of analysing the radiation which they emit

' The form of instrument adapted to the heavens is, however, not applicable to the atoms The spectrum of atomic radiation is formed by a grating, and Rayleigh showed that the power of a prism spectroscope is expressed approximately by the number of centimetres of available thickness of glass, which is one form of saying that, to get high definition or separating power, we must use interference depending on a great number of wavelengths retardation Michelson perceived that the retardation principle might be employed so as to make a grating which combined with its own effect the resolving power of a prism A slab of glass, a centimetre or more thick, might be used to give the necessary lag in phase of many thousand wavelengths, and thereby secure a definition and resolving power unthought of before So Michelson designed the Echelon spectroscope, consisting of thick slabs of glass, each protruding a millimetre or so beyond the other—a staircase spectroscope—which is now a regular instrument in the examination of the minute structure of spectrum lines

"What, however, is popularly the best known

work of Michelson is the application of his interferometer to determine if possible the motion of the earth through the ether The speed expected was of the order one ten thousandth of the velocity of light but since the journey of the light in the instrument is a to and-fro journey—one half-beam going as nearly as possible with and against the hypothetical stream of ether, while the other half beam goes at right angles to that direction—the amount to be measured was not one-ten thousandth but the square of that quantity, that is to say, the observer had to measure one part in a hundred million—no easy matter The interferometer was mounted on a stone slab floating in mercury, and the whole observation conducted with great care The result was zero, and that zero was used afterwards as the corner stone of the great and beautiful edifice of relativity"

WE regret to announce the following deaths

Mr St George Littledale, who was awarded the Patron's Medal of the Royal Geographical Society in 1896 for three important journeys in the Pamirs and central Asia, on April 16, aged seventy nine years

Sir Charles Lucas lately chairman of the Royal Empire Society (formerly the Royal Colonial Institute), distinguished as a historian of British colonial development, on May 7 aged seventy seven years

Mr Emil Torday a distinguished authority on the anthropology of Africa on May 9, aged fifty six years

News and Views

THE question of the introduction of twenty four hour reckoning for railway time tables has recently been discussed in Parliament The subject is a well worn one It is nearly half a century since the late Sir William Christie made efforts in this direction He suggested that, if it were done, astronomers might meet the public by reckoning astronomical time from midnight, a change that was actually made in 1925 A few years ago a committee appointed by the Council of the Royal Astronomical Society interviewed the railway authorities, endeavouring to persuade them to adopt the 24 hour system in time tables, pointing out that the method was already in use in many countries The companies, however, refused to make the change unless clear evidence was submitted to them that the public desired it It is, however, fairly obvious that the public is inarticulate in matters of this kind There was little enthusiasm for the summer time scheme until it came about as a war time economy, but once it was tried it was welcomed with enthusiasm by all except a small minority If the 24 hour scheme were adopted there would be no need to have new clock dials, the addition of 12 hours is an easy mental operation moreover, the use of the new time for time tables and public announcements would entail no obligation to use it in private life

FOR some little time the attention of the public has been specially directed to eastern affairs in such a way as to emphasise the need for appreciation of the distinctive features in Oriental culture as a basis of understanding More recently, however, the success of the exhibition of Persian art has given undue stress to the æsthetic side, which scarcely comes within the scope of NATURE It is for this reason that we have refrained from comment on the various suggestions for the foundation of a museum for Oriental or Asiatic art which have appeared in the correspondence columns of the daily press A proposal of a more comprehensive and scientific character is now put forward by the Royal Anthropological Institute At a recent meeting of the Institute's Joint Committee on Teaching and Research, which includes representatives from all the universities and institutions interested in anthropological and archæological studies, it was strongly urged that a central institute is needed to serve and guide the study of Indian and Oriental cultures as an expression of the thought and life of the people and that such an institute should include, as recommended by the Royal Commission on the National Collections, provision for the study and exhibition of the national collections from the scientific and technological as well as from the æsthetic point of view It was added that provision should be made in the Institute for the endowment of advanced teaching and research, and that its constitution should be on a federal basis, to permit the closest co operation with existing institutions devoted to such studies

THE bearing of the last suggestion is elaborated in a memorandum by Prof J L Myres which was circulated to the Committee and is published in *Man* for April It is there pointed out that the provision of a chair of Indian cultural studies, which has been suggested, is scarcely practicable, in view of the wide range of studies to be covered, while a series of chairs "in some British University' would not necessarily stand in the desired relation to the national collections On the other hand, there are in other university cities, as well as in London, long established and well supported centres of Oriental study such as the Indian Institute at Oxford This institute, as founded by Monier Williams, did indeed, on a small scale, anticipate the combination of library, museum, and provision for teaching and research such as is now contemplated and could alone cover adequately the study of art and technology, illustrate the thought and social structure of the people, and in the literature provide the interpretation of their culture A national institution of the type suggested might then be linked federally to all existing establishments by the structure of its directorate and the composition of its staff

THE Patent Office has recently made changes in the method of publishing its abridgments of specifications which should be noted by all who have to search through British patent literature Hitherto, the weekly official journal has always contained, in numerical sequence, the week's series of abridgments, the whole from year to year forming a complete numerical set for immediate reference purposes In addition, the abridgments allotted to each of the 271 classes into which the subject matter of inventions

is divided by the Patent Office have been collected together in five year periods and issued in class volumes with name and subject indexes Under the new arrangement, which came into force this year with specification No 340,001, the publication of the abridgments in the official journal has been discontinued, and they will now be issued only in separate weekly instalments divided into 40 groups, each of which comprises a carefully selected number of the old subject classes, when the whole series includes 20,000 abridgments (that is, roughly, every year), the abridgments of each group will be issued in volume form with their appropriate name and subject indexes The official journal contains each week a numerical list of the accepted specifications showing the groups in which the respective abridgments will appear

IT is too early to say whether the change which has been made in the method of publication of patent specifications will be appreciated by searchers The old arrangement provided a very ready reference to individual cases and a useful continuous record for libraries and others who had no space for the series of full specifications But, on the other hand, it was not particularly handy for a current subject search, and the old volumes of class abridgments lost a good deal of their usefulness by appearing so late The new group volumes will be considerably larger than the old ones, but the sheets will appear within a few weeks of the acceptance of the specifications and should thus prove of greater value for current search purposes (especially if the 'opposition' period is extended as is suggested by the recent Departmental Committee), and their separate subject indexes will replace the present annual consolidated subject index The annual accumulation of the group allotment lists which are printed in the journal each week will continue the numerical sequence of the earlier series of abridgments

THE annual report of the Council of the Institution of Professional Civil Servants again records a large increase in the membership of the Institution, which during 1930 rose from 6560 to 8452 It is noteworthy that, quite apart from 'observer' and 'technical assistant' staffs, the latter figure includes 1243 members of full scientific status employed in the various scientific branches of the Civil Service The outstanding feature of the year's activities was the submission to the Royal Commission on the Civil Service, which is now sitting, of a comprehensive statement of evidence embodying the Institution's case for a far reaching reorganisation of the scientific and technical services of the State It was urged that the existing multiplicity of professional, scientific, and technical grades should be rationalised and replaced by a simplified graded technical service As regards the relationships between administrative and technical staffs, it was proposed (1) that the respective functions of the technical and the non technical officers of the service should be redistributed in a manner which would give the expert wider powers of administration in his own department and enlarge the limits of his authority in regard to expenditure and the handling of staff, and (2) that arrangements should be made to ensure that the parliamentary head of a department is always fully aware of the views of his technical advisers In cases where the board system is not in operation, right of access to the Minister on all important questions involving technical considerations should be unconditionally vested in the heads of professional, scientific, or technical hierarchies In a friendly reference to the work of the Association of Scientific Workers, the Council expresses the hope that all eligible members of the Institution will become members of the Association, which, it states, is "the only body actively bringing the claims of the scientist to the notice of the public" Emphasis is laid on the essential unity of the scientific and technical services of the State

THE measurement of noise was the subject of the discourse given at the Royal Institution on May 8, by Dr G W C Kaye, superintendent of the Physics Department, National Physical Laboratory The 'yardstick' or 'degree' by which we measure noise is the decibel, a simple power ratio or logarithmic unit (NATURE, Jan 10, p 75) Although the measurement of noise is of considerable complexity, being bound up in part with physiology and psychology, the physics of acoustical measurement has made great strides both in facility and exactitude This is largely owing to the development of electrical methods based on the invention of the electronic valve By such means, noises can be analysed into spectra showing their frequency components, and their loudness can be measured physically by the microphone A convenient 'noise thermometer' ranges from 0 to 100 decibels, an upper level which is unlikely to be exceeded in everyday experience Conversational level is at about the half way point, 50 db The value for a quiet suburban street is 30 db, for a tube train 80 db Loudness levels of everyday noises have been determined by the National Physical Laboratory and by the Bell Telephone Laboratories and others in the United States New York traffic noises, both in the street and in the Underground, appear to be about 10 decibels louder than in London A modern car is quieter than a horse vehicle on a paved street Among the loudest things one is likely to encounter are the noises of rivetting, pneumatic road drilling, steamship sirens, and printing presses, but the arch offender of all is the aeroplane engine at close quarters (110 db) The noise in the cabins of aeroplanes in flight ranges between 80 db and 110 db, according to the type of machine There are, however, good prospects that the noise in aeroplane cabins will presently be substantially reduced (possibly to that of a railway train) by using propellers with lower tip speeds, providing more effective silencers on the exhausts, reducing engine clatter by enclosing the engines, and constructing cabins of double walls containing a suitable filler The question of protection from noise is being investigated at the National Physical Laboratory, and new sound-laboratories are to be erected in the near future

IN *Engineering* for April 24, a description is given of a clock that apparently can go on continuously until any part wears out It was made by T Dieden, of Carlslund, Sweden, and has already been going for fourteen years Although a self winding clock, it is a very near approach to perpetual motion In its main features it is very similar to an ordinary clock, having a driving weight, a train of wheels driving the hands, and a torsion pendulum consisting of a heavy metal disc suspended by a thin steel ribbon The unique feature of the clock lies in the method employed for winding up the driving weight The power is obtained by the ordinary variations of the atmospheric pressure and temperature The case of the clock contains seven closed elastic metallic boxes of the type used in an aneroid barometer The lower box is attached to the case, but the column of boxes is otherwise free The total expansion or contraction of all the boxes due to changes in the temperature or pressure is communicated to the top box This is connected to two pawls working in opposite directions When the column of boxes either increases or diminishes in height, the spindle carrying the ratchet wheels always rotates in the same direction and the driving weight is wound up Fixed pawls prevent the ratchet wheels from running back When the weight reaches its topmost position they are thrown out of action With its weight fully wound up, the clock can run for eighteen months without stopping, and it would be exceedingly unlikely for the temperature and pressure to remain constant over such a long interval The pendulum has a period of $7\frac{1}{2}$ seconds, so that the length of the equivalent simple pendulum is about 185 ft

THE Annual Report of the Zoological Society of London records a successful year the number of fellows has increased (from 8344 last year to 8430), the subscriptions of fellows have increased, the number of visitors to the garden in Regent's Park has increased, very considerably exceeding the two million mark, gate money has increased, and with it all the expenditure for the year has fallen, so that a favourable balance of £1479 is carried forward The health of the stock has been satisfactory, and the death rate is still moving, although almost imperceptibly, in the right direction Its decline should be hastened by the formation of an isolation ward, where epidemic diseases may be checked at the outset Chance injuries and accidents account for most of the deaths, 230, or 18 9 per cent Then follow diseases of the respiratory system, which, even when tuberculous and mycotic infections are excluded, account for 177 deaths, or 14 6 per cent, diseases of the digestive system follow with 166, or 13 7 per cent In addition to the isolation hospital, there have been created several new buildings, of which the parrot house and bird diving house, in the old refreshment room building, and the butterfly cage appeal most to the inhabitants and to visitors

PERHAPS readers will turn most eagerly to discover how the zoological park at Whipsnade is progressing Much has been accomplished since the last Report of the Zoological Society Hall Farm has been transformed into a restaurant, and the old fellows' pavilion has been transported from Regent's Park to the Downs More than three miles of internal roads have been made, four chalk pits, ultimately to become carnivore dens, have been excavated for road metal, much planting has been done, and already enclosures and paddocks are well stocked with a considerable variety of the larger birds and mammals As has already been announced, Whipsnade Zoological Park will be opened to the public on Saturday, May 23, the previous day being set aside as a private day for fellows of the Society and official guests Capt W P B Beal, late Principal Veterinary Officer of the Gold Coast, has been appointed Superintendent of the Park for one year

AT a special meeting of the Council of the Ray Society on April 30, the following resolution was adopted "The Council of the Ray Society desire to place on record the profound grief felt by them on hearing of the death of their President, Professor W C M'Intosh, F R S, on April 1st last Professor M'Intosh had belonged to the Society since 1863 and had been President since 1913 He had not only shown his practical interest in its success by his exceptionally long period of membership, but he had given the most devoted service to the Society by his frequent journeys from St Andrews to London, in order to attend the meetings of the Council, at which he nearly always presided The Council direct that this record of their appreciation of the value of their late President's work be sent to Dr R T Gunther, his nearest surviving relative, with the expression of their sincerest sympathy" Sir Sidney F Harmer, the treasurer of the Society, was elected president *ad interim* in succession to the late Prof M'Intosh

RECENT Norwegian work in the Antarctic region has resulted in several new discoveries of coast line Several years ago, Mr L Christensen detailed one of his ships, the *Norvegia*, for exploratory purposes New land was discovered to the west of Enderby Land, called Queen Maud Land, and to the north east of Coats Land, called Princess Martha Land News now comes of further discoveries in the southern summer that has just ended The *Times* recently recorded the discovery by Capt Riiser Larsen, flying from the *Norvegia*, of a further stretch of coast line between the two already mentioned This is Ragnhild's Land and extends from lat 68° 40′ S, long 33° 30′ E, to lat 70° 30′ S, long 24° 15′ E The *Geographical Journal* for April contains news from Mr Christensen of the sighting of more land, this time apparently to the east of Enderby Land and MacRobertson Land which Sir Douglas Mawson discovered The new coast line lies in lat 68° S and extends from long 65° E to 71° E Thus there appears to be a considerable bight in the coast of Antarctica between MacRobertson and Wilhelm Lands The *Norvegia* concluded the season's work by circumnavigating Antarctica and confirming the non existence of various doubtful islands

THE production of books seems to maintain its very high standard, especially in Great Britain and the United States, in spite of trade depression This is due probably to the large number who are

now taking advantage of the opportunities offered for advanced education, for, in spite of the great number of publications in fiction (by far the greatest of all) children's books, religion, biography and travel, and other books of a general character, which reach the same percentage in Great Britain and the United States, a good proportion of books is in the specific sciences. With the great advances made in aeronautics, there is a corresponding increase in the number of British publications, which according to the *Publisher and Bookseller*, reached the total, in 1930 of 133. Only 26 books on wireless appeared in 1930, topography and folk lore show a total of 205, while botany, horticulture, and agriculture stand at 176, anthropology 35 chemistry and physics 116, astronomy and meteorology 50 engineering sciences 115, geology 53 mathematics 37, medicine 456, zoology 163, and psychology 64. The total number of British books published in 1930 was 15,494 of which 3638 were new editions. It is gratifying to the man of science to note that the 209 limited editions still remain in the letters groups there being practically no such publications in science. According to the list of publications in the United States in 1930 which appears in the *Publisher's Weekly* the number of American books produced last year reached 10 027 of which 1893 were new editions. These figures are much below the corresponding figures for Great Britain.

IN the first of a new series of *Tyneside Papers*, issued by the Tyneside Council of Social Service, the trend of population in that area is compared with the results of an earlier survey published in March 1926. It was then pointed out that population was growing more rapidly than industry was expanding and that a new equilibrium would be brought about slowly through (1) a further decline in the birth rate, (2) further migration, (3) a partial recovery in the old staple industries, and (4) the expansion of minor industries and the starting of new industries. So far, the staple industries have not recovered, and, apart from the electrical industry, there has been little expansion of other industries. The situation, however, has entirely changed in regard to the birth rate and migration. The average yearly natural increase in population for the years 1926–29 was only two thirds of what it was in the earlier period 1921–26. In the second period, the annual outward balance of migration from Tyneside was about six times as much as that in the first period, and, if this exodus should continue, it would do much to reduce unemployment. Many would naturally wish that the situation could be re adjusted by revival of local industries rather than by loss of population, and the question suggests itself whether some of the industries presumably absorbing the inflowing population in the south could not be established on Tyneside.

THE thirty sixth annual congress of the South Eastern Union of Scientific Societies will be held at Winchester on June 10–13, under the presidency of Sir J Arthur Thomson. The presidential address on "Some Natural History Problems of the Countryside", will be delivered in the Guildhall on June 10. The various sections will open their sessions on the following days. Mr James Groves, president of the Botanical Section, will discuss ancient and modern stoneworts, in his presidential address. In the Archæological Section the president, Dr W E St L Finny will take as his subject the kings of Wessex, from Egbert to Athelstan. The president of the Geological Section is Prof H L Hawkins, who will discuss the nature, deposition, and palæontological implications of the Chalk. Mr J F Marshall, as president of the Zoological Section, will describe some stereoscopic photomicrographs of fossil insects to be exhibited by him in the Congress museum. Archæological surveys will form the topic of the presidential address of Mr H J E Peake before the Regional Survey Section. Several useful and interesting excursions have been arranged in connexion with the Congress. On June 13, the preservation of the countryside and the various parliamentary bills concerned with it will be discussed, Sir Lawrence Chubb and Sir Edgar Bonham Carter taking part in the discussion.

MESSRS Adam Hilger Ltd, the well known optical instrument manufacturers, have issued a pamphlet giving a general account of the products and aims of the firm and outlining the scope of its activities. The high quality of the Hilger products is generally recognised and the pamphlet reveals that the total value of the instruments exported by the firm during the last five years is three times that of the instruments supplied to the home market. The selected list of purchasers given at the end includes institutions from all parts of the civilised world. There is probably justification for the surmise that "most of the research of the world in certain fields of prime importance in modern physics is being done with Hilger instruments". Particular attention is given in the pamphlet to the industrial applications of scientific manufactures and there is an account of work of this kind connected with the metallurgical and chemical industries, mineralogical survey and the utilisation of ores, engineering design, the colour industries (paints, textiles, artificial silk etc), the manufacture of glassware and the manufacture of optical instruments (cameras, microscopes, telescopes, binoculars, etc). The publication is an interesting one, and the only point which calls for criticism is the retention of the accents and the capital initial letter in the word 'angstrom' used as a unit of wave length. It is time that the name of this unit took its place with 'ampere', 'henry', 'ohm', and many others of similar origin, as a common noun.

THE first of this year's Royal Society conversaziones will be held in the Society's rooms at Burlington House on Wednesday, May 20, at 8 30 P M.

SIR JAMES FRAZER, the distinguished anthropologist and author of "The Golden Bough", has been elected an Honorary Master of the Bench of the Middle Temple.

SIR ARTHUR KEITH, Hunterian professor and Curator of the Royal College of Surgeons, has been elected a foreign member of the American Philosophical Society, Philadelphia.

THE following appointments in the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies – Mr B J Weston, to be horticulturist, Cyprus, Mr J S Norman, to be field instructor, Federated Malay States

THE sixteenth of the public lectures on "Physics in Industry" arranged by the Institute of Physics will be delivered on May 19 at 4 30 P M, at the Institution of Electrical Engineers, by Mr Alan F L Chorlton, who will take as his subject "Physics in Relation to the Development of the Internal Combustion Engine"

IN NATURE for May 9, p 714 it is stated with reference to the Lancashire earth shake of May 3 that tremors were not registered at the Liverpool Observatory and Tidal Institute Mr H J Bigelstone, principal assistant at the Observatory, informs us that this is incorrect Tremors were recorded on the Milne Shaw seismograph there, commencing at 9 h 23 m 0 s and lasting 40 sec The maximum amplitude recorded was 1 5 mm

IT is reported in *Science* that Dr Werner Heisenberg, professor of theoretical physics at the University of Leipzig has been awarded the Barnard Medal of Columbia University Every five years the National Academy of Sciences recommends to the trustees of Columbia University a nominee for the Barnard Medal "for discoveries in physical or astronomical science or novel application of science to purposes beneficial to the human race" The previous recipients of the medal have been Lord Rutherford 1909, Sir William Bragg 1914, Prof A Einstein, 1921, and Prof Niels Bohr, 1925

THE Council of the Royal Society of Edinburgh has awarded the Makdougall Brisbane Prize, for the period 1926–30, to Dr Nellie B Eales Zoology Department, University of Reading, for her papers "On the Anatomy of a Foetal African Elephant" published in the *Transactions* of the Society The Bruce Preller Lecture to be delivered on July 6 by Prof Horace Lamb, will be devoted to a commemoration of the centenary of the birth of James Clerk Maxwell On June 15, Prof A H R Buller, professor of botany in the University of Manitoba, will address the Society on "Recent Advances in our Knowledge of the Higher Fungi"

THE International Institute of African Languages and Cultures has issued invitations to a congress to be held in Paris on Oct 16 19, when the Exposition Coloniale Internationale will still be open The Congress will deal with important linguistic and anthropological problems of the Africa of to day Prof Antoine Meillet, president of the Institut d'Ethnologie, will act as president of the Congress, and Prof Henri Labouret as vice president The Congress will be opened by Maréchal Lyautey and Lord Lugard will speak on the aims of the Institute The meetings will be held at Vincennes An interesting feature of the programme is a lecture by Dr Chauvet on African music, which will be illustrated by songs and dances by African performers Visits to the appropriate museums and collections are being arranged

THE Gold Medal of the Institution of Mining and Metallurgy has been awarded to Dr Charles Camsell, deputy Minister of Mines and Industries of the Dominion of Canada "in recognition of his untiring zeal and great ability in promoting the development of the natural resources of the Dominion and in furthering the general interests of the mineral industry" The following awards have also been made The Consolidated Gold Fields of South Africa, Ltd, Gold Medal to Mr C W B Jeppe, for his researches on mine ventilation at great depths, and for his paper on "Ventilation at the Crown Mines, Witwatersrand" the Consolidated Gold Fields Premium of forty guineas to Mr J G Lawford, for his "Notes on Some Stoping Problems in Mexico", and the William Frecheville Student s Prize of ten guineas to Mr W H Wilson for his paper on 'Bottom Slicing applied to Mining a large Irregular Replacement Deposit in Limestone"

IN a 4 page pamphlet Mr P I Harwood, of "Corona" Ovingdean Brighton, puts forward a theory of the Michelson and Morley experiment based on his definition of motion as 'a process of extending a body in a particular direction' which confers super extension on the body" and it acquires "a length longer than its static length" According to Mr Harwood, the increase of thickness of the mirrors in the line of motion compensates for the increase of the path of the light in that line He does not mention the increase of length of the support of the mirrors in the line of motion, which his theory of motion requires and his readers are left in the dark as to why the super extension is limited to the mirrors We have been unable to verify the author s statement that Sir James Jeans 'says that the sun, instead of sending us light waves, sends us nothing more substantial than mathematical equations"

MESSRS Bowes and Bowes, Cambridge in catalogue No 457 offer upwards of 400 books in new condition at greatly reduced prices The list is one of general interest, but in it are several works of a scientific character, particularly in the departments of archæology travel, and natural history

APPLICATIONS are invited for the following appointments on or before the dates mentioned – An organiser of agricultural education under the Middlesex County Council– The Secretary, Middlesex Education Committee, 10 Great George Street, S W 1 An assistant in the department of radium therapy and research of the Middlesex Hospital –The Secretary Superintendent, Middlesex Hospital, W 1 (May 20) A resident lecturer in mathematics, with physics, at the Borough Road Training College, Isleworth—The Principal Borough Road Training College, Isleworth (May 23) A head of the department of continuative education of Loughborough College—The Registrar, Loughborough College, Leicestershire (May 23) An assistant lecturer in economics at University College of the South West of England –The Registrar, University College of the South West of England, Exeter (May 25) A graduate teacher of electrical engineering subjects for the Junior and Technical Day School and Evening Classes of the Wandsworth

Technical Institute—The Secretary, Technical Institute, Wandsworth S W 18 (May 30) An assistant lecturer in chemistry at Brighton Technical College—The Secretary, Brighton Technical College, 54 Old Steine, Brighton (May 30) An assistant in textile research, for research work relating to the knitting industry, in the department of textiles of University College, Nottingham —The Registrar, University College, Nottingham (June 1) An inspector of explosives under the Home Office—The Private Secretary, Home Office, Whitehall, S W 1 (June 5) An assistant lecturer in physics in the University of Manchester—The Registrar, University Manchester (June 6) A lecturer in metallurgy an assistant lecturer in civil engineering, an assistant lecturer in electrical engineering, and an assistant lecturer in mathematics, each in the faculty of engineering of the University of Bristol — The Secretary and Acting Registrar, University, Bristol (June 9) A lecturer in agricultural chemistry and physics at Swanley Horticultural College for Women—The Principal, Swanley Horticultural College for Women, Swanley, Kent (July 6) A science mistress for physiology at the Bedford Physical Training College—Miss Stansfeld, Bedford Physical Training College, 37 Lansdowne Road, Bedford Two assistant organisers for help in the development of the Young Farmers' Club movement in the north and west of England respectively —The National Association of Young Farmers' Clubs, 26 Bedford Square, W C 1

Our Astronomical Column

Pluto —*Popular Astronomy* for April contains Prof V M Slipher's report on the Lowell Observatory, in which there are some more details about Pluto It was not until Feb 18, 1930, that Mr Tombaugh discovered the images on plates taken on Jan 23 and 29, and afterwards that on the plate of Jan 21 It was examined visually with the 24 inch refractor "No certain evidence of disk could be made out, although on a few occasions its image seemed not quite like those of equally faint stars" "Later tests indicated that with Pluto's faintness his disk, if as much as 0 6″, could escape detection under good observing conditions" This would imply a diameter of 11,000 miles It was found that Pluto was brighter visually than photographically, so a yellowish colour was inferred

The report also states that "the search of the ecliptic with the efficient 13 inch telescope is being continued by Mr Tombaugh A band of considerably greater width is being carried round the sky, and the reach in magnitude of stars included has been increased"

Rech Instit Circ 425 contains the following observations of Pluto made at Simeis by S Beljawsky

1931	U T	R A 1931 0	N Decl 1931 0
Mar 22^d	18^h 22 8^m	7^h 21^m 9 91^s	22° 20′ 39 4″
,, 23	18 12 0	7 21 8 99	22 20 45 6

The magnitude was 14 5 Prof M Wolf gave it as 14 on Feb 8

The above *Circular* also contains the following revised orbit of 1931 *FE*, which is the interesting minor planet discovered by Drs Schwassmann and Wachmann in March It is by A Kahrstedt

Epoch 1931 April 7 0 U T

$$\left.\begin{array}{ll} M & 31\ 20^\circ \\ \omega & 129\ 62 \\ \Omega & 1\ 20 \\ i & 24\ 26 \end{array}\right\} 1931\ 0$$

$\log q$ 0 2439

Period 3 713 years

The perihelion distance is 1 754, the eccentricity 0 2687

Spectroscopic Parallaxes of *B* type Stars —The Commonwealth Solar Observatory at Canberra has recently published *Memoir* No 2, containing an investigation of southern *B* type stars by B W Rimmer for determining spectroscopic parallaxes The method used by Rimmer is essentially the same as that of Edwards, who amplified an earlier method of Adams and Joy It consists in (*a*) accurately classifying the spectral types of the stars on the basis of the Harvard classification but with additional sub types interpolated, and (*b*) dividing each sub type into groups according to the sharpness of the spectral lines Both type and line sharpness are correlated with absolute magnitude, and the final results give reasonably good values of the parallaxes Struve has recently shown such methods to have a sound physical basis, also his parallaxes (derived from interstellar calcium lines) show a good correlation with the results obtained by them, though indicating that the dispersion of absolute magnitudes is probably too restricted Rimmer's method differs from that of Edwards in the formation of two extra groups, for bright line stars and peculiar stars, also, the instrument used gives spectra double the length of those obtained at the Norman Lockyer Observatory, Sidmouth, by Edwards For those stars, however, which are common to the two observers (170 in number) the parallaxes are in fairly good agreement A full discussion is given both of the instrumental equipment and the method used in deducing parallaxes The final results for 350 stars form a useful addition to our knowledge of stellar distances, being in numerous instances the only available source of information for southern *B* type stars This is the first volume of a purely astronomical character to be issued from Canberra, and it will be welcomed by astronomers

The Eighth Satellite of Jupiter —*Yale Astron Transactions*, vol 6, part 4, contains a new theory of this satellite by Prof E W Brown As is well known, the theory of this satellite is extremely difficult, owing to its great inclination and eccentricity and the very large solar perturbations Prof Brown has diminished these difficulties by the use of a doubly periodic intermediate orbit the two periods are that of the elliptic terms and that of the Variation The work was carried out before the recent recovery of the satellite, so the constants were derived from the observations of the first six or seven years The ratio of the mean motions (Sun to J VIII) is −0 171171, giving 741 613 days for the sidereal period, the mean inclination, 31° 13′ The eccentricity is at present taken as exactly 0 4 The mean motion of the perijove is −0 00163 *n*, where *n* is the mean motion of J VIII The perijove therefore takes more than 1200 years to make one revolution The fact of the motion being in the reverse direction to the satellite was unexpected, it arises from the second order terms exceeding those of the first order The mean motion of the node is −0 02193 *n*, hence the node goes round in about ninety years The coefficients of the inequalities are given in the article

Research Items

Stone Implements of Types new to Southern India.—Six stone implements of types not hitherto recorded in India are figured and described by K. Sripada Rao in the *Journal of the Mysore University*, vol. 4, pt. 2, July 1930. They are selected from among four hundred and fifty implements collected on geological excursions of the Central College, Bangalore. It is suggested that of the six types, four, from Reddipalle, Cuddapah District, of Cuddapah quartzite, represent an advance on the Lower Palæolithic (Acheulean) culture of Biligere, Mysore, while the last two, from Trichinopoly and Ranganathpur, Mysore, belong to the Middle Palæolithic. The first implement is triangular with incurved sides. One surface is concave and shows no sign of working, the other has a small central triangular platform of which the sides are parallel to the sides of the implement, giving it the appearance of a truncated triangular pyramid. Similar specimens were collected from widely separated areas such as Satyavedu, Alicoor Hills, and Kibbanhalli (Mysore). The nearest parallel is a 'tribrach' from the Isle of Wight, described by Sir John Evans, and compared by him to specimens from Yucatan and Russia. The second implement is roughly triangular with rounded angles and has one surface chipped in three broad triangular faces longitudinally disposed. It closely resembles the Stellenbosch 'cleaver'. The third implement is horseshoe shaped. The worked surface is covered by six broad flaked faces, the three big ones forming, with the back, the three straight cutting edges, of which the main one is opposite the curved edge of the horseshoe. The fourth implement is roughly rectangular. The worked surface (one side only) shows four big flakings, of which the one longitudinally disposed forms the cutting edge. Of the two remaining implements, the one from Trichinopoly, of yellow cherty material, is crescent shaped. The convex edge, 8¾ in. in length, is thin and sharp, the concave edge is also sharp. One end is pointed, the other has a ridge, and it is suggested that this was inserted in a handle to enable both edges to be used. The sixth implement, from Ranganathpur, is of white and greasy looking quartz reef, stained red by iron oxides. It is of the shape of an ox head with ledge like notches in the place of the ears. These make the implement probably unique in India and perhaps indeed elsewhere. It is suggested that the rounded and sharp-edged butt, which affords no hand hold, was intended to fit in a slotted handle.

Pneumoconiosis caused by Talc.—Although talc powder finds a number of industrial applications, comparatively few instances of pulmonary affections traceable thereto have been recorded. In the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere for 1930, Dr. Arturo Zanelli describes the case of a workman employed in a pneumatic tyre factory to inject powdered talc into the interior of the tyres and to apply the same material to the outer surfaces of the tyres by means of a cloth. During this work, the air contained a dense dust, but no masks were provided for the employés and no other means was adopted for their protection from the dust. The man developed grave digestive troubles, and X-ray examination of the lungs revealed the presence of the nodular formations typical of pneumoconiosis. Although talc has been regarded as a mineral forming a dust which only rarely has pathogenetic qualities, one of its properties seems to render it particularly dangerous. It forms extremely minute particles which do not irritate the sensitive nerve endings of the mucus on which they are deposited, so that such important means of defence as sneezing, coughing, and increased secretion are not brought into operation. In the case considered, indeed, the patient exhibited, during working hours, a weakening of the olfactory sense, the layer of dust on the mucus preventing the transmission of the olfactory stimuli to the nerve endings.

Respiration in Insects.—In *Biological Reviews* of the Cambridge Philosophical Society, vol. 6, No. 2, 1931, pp. 181-220, Dr. V. B. Wigglesworth gives an admirable summary of our present day knowledge of respiration in insects. A very extensive literature has grown round the subject during the last twenty years or so, and, in sifting this mass of information, the author has undertaken a task of considerable difficulty. His review covers the ground of external and internal respiration in insects: the histology of the tracheal system is fully described, while the supply of air to the tracheoles, the respiratory movements, the elimination of carbon dioxide, and the respiratory function of the blood all come under review. The respiration of aquatic insects is also very fully discussed, and there is a brief account of the same process in parasites. The ultimate endings of the tracheæ are capillary tubes, or tracheoles, often less than 1μ in diameter. The problem as to whether these fine tubuli contain fluid or air, a subject which Dr. Wigglesworth has specially studied, is discussed from its biophysical aspect. The exchange of gases in the tracheal system, as a whole, is effected primarily by diffusion, which is modified by the opening and closing of the spiracles. The relative importance of the spiracles and the integument with regard to the elimination of carbon dioxide is another important aspect of the subject, and it is evident that we know little as yet with regard to the rôle played by the skin. While there is indirect evidence that the blood acts as a carrier of oxygen to the tissues, it is still a very moot point whether it contains a respiratory protein analogous to hæmocyanin or hæmoglobin. It is only in certain very special cases that hæmoglobin is present in insects and functions as an oxygen carrier; but in the vast majority of these creatures no carrier has been identified. At the end of Dr. Wigglesworth's paper there is a bibliography, of about three hundred references, which will be found of service to all interested in the subject.

Indian Forest Plants.—In *Indian Forest Records* (Botany Series), vol. 16, pt. 1 (1931), Mr. R. N. Parker, forest botanist at the Research Institute, Dehra Dun, India, continues his illustrations of Indian forest plants with plates and notes of five more species of the genus *Dipterocarpus*. The first part of this work appeared in vol. 13, pt. 1 (1927), of *Indian Forest Records*, and was mentioned in NATURE, five species of this genus then being dealt with. The species here treated of are: *D. Baudii*, *grandiflorus*, *obtusifolius*, *Dyeri* and *Kerrii*. Excellent plates depict the species. Mr. Parker has an interesting note on the hybridisation of different species. He writes: "I am of opinion that the various species of Dipterocarpus hybridise freely in nature. The hybrids most often met with appear to be between the *ins* (rough barked dipterocarps), *D. obtusifolius* and *tuberculatus*, and one of the *kanyins* (smooth-barked dipterocarps)." The hybrids *D. costatus* × *obtusifolius* and *D. tuberculatus* × *turbinatus* seem to be of frequent occurrence. Other hybrids also appear to occur, though the evidence for them is not always very satisfactory. Dr. Kerr, a botanist

keenly interested in the Malayan flora, was the first to detect and describe a hybrid *Dipterocarpus*

New Arctic Islands —The Arctic seas between Franz Josef Land and Northern or Nicholas Land have seldom been penetrated, owing to congestion of heavy ice The *Italia* airship passed over the region in 1928 but made no discoveries In the summer of 1930, the Russian Arctic expedition under Prof O Schmidt, in the icebreaker *Sedov*, after relieving the meteorological station at Hooker Island, Franz Josef Land made an attempt to reach Northern Land, of which the western side is unknown In spite of heavy ice, the expedition had a great measure of success and made several discoveries of importance An account of the voyage by Prof. R Samoilovitch, with a map of the discoveries, appears in *Petermanns Mitteilungen* Hefte 3/4 1931 A low, flat island of Palæozoic sandstone (Wiesse Island) was found in lat 79° 27′ N 76° 40 E A second island, Issatschenko Island was found fifty miles south east of the island known as Einsamkeit or Lonely Island which however was not seen A third island called Voronin Island was found in lat 78 N long 93 30′ E (approximately) Farther north, a number of small islands of Palæozoic limestone were discovered about fifteen miles from the west coast of Northern Land On one of these islands of the Kamenev Group in lat 79 6′ N, long 90 33′ E a new meteorological station was established and provisioned for three years The party of four men is provided with dogs and could retreat to the Siberian coast if relief by ship were impossible Finally, the expedition discovered another island Schmidt Island, in lat 81 5 N, long 89 40′ E This island is completely ice covered

The Idu (Japan) Earthquake of Nov 26, 1929 —A preliminary report on this earthquake by Prof A Imamura (*Tokyo Imp Acad Proc*, vol 6, pp 419 422, 1930) shows that it presented phenomena of much interest The shock was destructive in two areas, the centres of which are about 14 miles apart Of the faults that appeared with the earthquake, three are especially noteworthy One, about 6½ miles long runs north and south along the neck of the Idu peninsula The dislocation along this fault in a railway tunnel shows that, at a depth of 500 feet, the crust on the west side had shifted 7 ft 10 in southwards and 2 ft downwards with reference to the other At the surface the dislocation was much less apparent The other two faults may be continuations of this fault that at the south end being 11 miles long and trending S 30° W The crust on its west side was shifted relatively 4 ft 3 in to the south with an upthrow of 1 ft 8 in The fault at the north end is much smaller and trends to the north west The seismographic evidence shows that the first movement came from near Ukihasi (lat 35° 2′ N, long 139° 0′ E) The block movement thus seems to have started near the central point of the fault system passed quietly over the middle fault, and increased greatly along the two oblique terminal faults Round these faults are situated the two meizoseismal areas, in which 259 persons were killed and 2142 houses destroyed About 4½ miles to the east of the southern area lies the small town of Ito, at and near which were felt the numerous slight shocks of the previous spring (NATURE vol 126, pp 326, 971, 1930) About the time of the Idu earthquake the Military Land Survey was engaged in relevelling the district One section was levelled the day before the earthquake and in the opposite direction the day after A comparison of the two series showed that practically no change had occurred in this portion of the peninsula The relevelling and retriangulation of the whole area are now in progress and seismographs have been erected at four stations around the epicentres (*Tokyo Imp Acad Proc*, vol 6, pp 399 400, 1930)

High-Speed Wind Channels — A paper by Sir Thomas Stanton in the March number of the *Proceedings of the Royal Society* contains a history of recent progress in the development of high speed wind channels for research in external ballistics The fundamental idea of the work is to measure the forces and couples to which a projectile is subject, by means of scale models in which the body is held stationary in a current of air moving at high speed The earlier work was done with the momentary blasts of air which were produced by the release of a volume held at high pressure, this proved unsatisfactory, partly because of the difficulty experienced in obtaining speeds greater than that of sound but more particularly because it was found that complicated systems of stationary waves formed in the jets so that it would be almost impossible to know the exact conditions to which the model was subjected The later work has been carried out in a continuous air current and it has now been found possible to devise systems in which the air current is reasonably uniform over a sufficiently large region to contain a small model, and in which the forces on the model can be measured with relative ease A considerable amount of investigation has been done on these lines but it has been found that the conditions in the channels are extremely sensitive to quite small changes in the entering air This rather limits the usefulness of the method, and it is suggested that the next stage in the work should consist in bringing such conditions under better control

Stark and Zeeman Effects —Two papers in the March number of the *Proceedings of the Royal Society*, by Prof J S Foster on the effects of electric and magnetic fields on the helium spectrum and by J K L MacDonald, on the Stark effect in molecular hydrogen in the range 4100 4770 A add considerably to knowledge of these phenomena Prof Foster's contribution is largely concerned with the combined effects of magnetic and electric fields a subject which has played an important part in the development of quantum theory but for which few data are available Amongst the numerous results may be noted the appearance of lines in crossed fields for which the change in the magnetic quantum number (Δm) appears to be more than one unit Mr MacDonald's paper deals only with the pure electric resolution of the band lines, extending and partly checking earlier work by Kiuti This investigation of molecular hydrogen is of considerable difficulty, both experimentally and in its theoretical interpretation In addition to the use of Lo Surdo tubes of rather curious design, with restriction of the path of the discharge in front of the cathode, it was also found necessary to employ streaming gas, admitted from below the cathode, and, in order to obtain details of the line structures, to sacrifice field strength to obtain a steady and bright source The scale of the resolution of the lines compared with the splitting of the lines of atomic hydrogen, appears clearly on a plate accompanying the paper

Structure of the Atomic Nucleus — Latimer, in the March number of the *Journal of the American Chemical Society*, points out that the abundance curve for lighter elements, the atomic weights of which are approximately integral multiples of four, shows maxima for 4, 7, 10 12 and 14 alpha particles, which suggests that the alpha particles are arranged in a tetrahedral pattern He proposes an arrangement of 4 alpha particles in a tetrahedron with a certain coupling of proton spins and, by continuing the

pattern to 10 alpha particles, finds a point in the lattice about which four protons converge in the same manner as in the alpha particle. The entrance of a pair of electrons at this point explains the first pair of extra electrons found in argon (40), and an extension of the principle appears to give a complete explanation of the numbers of extra electrons required in the heavier elements. With the addition of the extra electrons, the proposed nuclear structure becomes a diamond shaped lattice of electron pairs joined by protons. The model may be interpreted as the pattern determined by the directions of the proton spin vectors, the angle between any two proton vectors being that formed by lines from two corners of a tetrahedron to its centre. This is the angle at which two elementary spin vectors add to give a resultant of two units. The quantity $\frac{1}{2}\sqrt{n(n+2)}$ is the magnitude of the vector representing n units of spin, and only resultants with integral values of n are permitted. The geometry of the tetrahedron is thus clearly seen to be that demanded by quantum mechanics for the combination of two unit spin vectors. The paper is illustrated by representations of models, which add considerably to the clearness of the ideas put forward in it.

Atomic Weight of Iodine.—In an investigation of Baxter and Tilley in 1909, the ratio of silver to iodine pentoxide was found to be 0·646225, whereas the values Ag = 107·880 and I = 126·932 give 0·646251 (isotopic oxygen mixture = 16·000). It is now shown by Baxter and Butler in the March number of the *Journal of the American Chemical Society* that the ratio Ag/I_2O_5 is affected by two sources of error: (1) the adsorption of air by very porous iodine pentoxide, and (2) the fact that iodine pentoxide produced by the dehydration of iodic acid appears to contain less iodine and more oxygen than corresponds to the formula I_2O_5. Whilst the modern value for the atomic weight of iodine rests on several well-established ratios to silver and to the other halogens, it would be necessary in order to reconcile the experimental values of the ratios of silver and iodine to iodine pentoxide with the theoretical values to increase the atomic weight of iodine by 0·005 unit in the former case and decrease it by 0·03 unit in the latter. Great care was taken in the purification of the iodine pentoxide, which was then decomposed by heating at about 400° in a weighed quartz reaction vessel which contained hot silver to prevent escape of iodine, and finally the weight of the iodine was determined. Water retained by the pentoxide was collected in a weighed absorption tube and correction of 0·001 per cent for adsorbed air was made. The ratios I/O and I_2/I_2O_5 were found to be 3·17262 and 0·760342, which would correspond with I = 126·905, which is considered to indicate an excess of oxygen of 0·005 per cent in the pentoxide above the theoretical value. Iodine pentoxide of normal composition has not been prepared.

Hydrogen Ion Concentration in Unbuffered Solutions.—A platinised electrode in a hydrogen atmosphere adsorbs the cation or base from a salt or base solution, thus yielding a more acid solution in the cell than before treatment with hydrogen. This forms a serious objection to the use of the ordinary type of platinised platinum electrode in unbuffered solutions. Again, since acid base indicators are weak acids or bases, large errors may be caused in their use in measuring the pH of pure water or extremely dilute solutions of acids or bases. These problems are discussed in three papers in the March number of the *Journal of the American Chemical Society* by Kolthoff and Kameda. In the first, it is shown that acid adsorbed by platinum can be removed by washing with water in a hydrogen atmosphere. An electrode coated with a bright layer of platinum was used, which gave satisfactory results in unbuffered or slightly buffered solutions. The electrode after platinisation, is treated with hydrogen bubbled through water, and the cell then washed out and solution admitted. The electrodes are easily poisoned and are replated after each set of measurements. In the second paper the use of mixtures of two forms of an indicator in different ratios is described, the indicator being isohydric with the solution. The colour in the unbuffered solution is compared with that in an ordinary buffer solution with the same indicator mixture, a correction for the difference of ionic strength of the two solutions being applied. In the third paper, the hydrolysis of zinc sulphate solutions was investigated. The second paper emphasises the importance of using pure indicators, the commercial products not always being satisfactory in this respect.

Corrosion of Copper.—The green patina produced on copper by more or less prolonged exposure to moist air is generally stated to be a basic carbonate. In two papers in the *Journal of the Institute of Metals*, (vol 42, p 181, 1929; vol 44, p 389, 1931), Vernon and Whitby have reported analyses of the deposit formed in different localities in England, and these show that in the particular samples examined the main constituent is a basic sulphate of copper, with very little carbonate. In some specimens from coastal towns there was chloride; in specimens from Lowestoft there was a considerable amount. In only one specimen was there no carbonate. London samples contained copper sulphide, sometimes to the extent of more than 10 per cent, and the action of hydrogen sulphide is considered to play an important part in the corrosion. In the second paper, it is shown that the compositions of the materials of the patina more than seventy years old correspond with the natural minerals brochantite $CuSO_4 \cdot 3Cu(OH)_2$, atacamite $CuCl_2 \cdot 3Cu(OH)_2$ and malachite, $CuCO_3 \cdot Cu(OH)_2$. There is an interesting general discussion at the end of the second paper.

Solid Polyiodides of Potassium.—Although solid polyiodides of cæsium, rubidium and ammonium have been shown definitely to exist at ordinary temperatures, whilst no solid polyiodides of sodium and lithium are reported, the solid polyiodides of potassium have been the object of several researches which have led to conflicting conclusions. Up to the present, four investigators have considered that they have prepared KI_3, although only one reports analyses supporting his results, whilst two have obtained evidence for its existence. At least four investigators have failed to obtain it, or have given evidence against its existence. There is a similar conflict of evidence in the case of KI_7. In the March number of the *Journal of the Chemical Society*, N. S. Grace has shown that the solid polyiodides obtained from aqueous solutions contain water of crystallisation, the two compounds $KI_3 \cdot H_2O$ and $KI_7 \cdot H_2O$, stable at 25°, being isolated. Previous work of Abegg and Hamburger which had been interpreted as indicating the existence of KI_7 is shown to be substantially accurate, but the polyiodide was shown to contain two molecules of combined benzene $KI_7, 2C_6H_6$. Evidence is given that no unsolvated polyiodides of potassium exist at 25°. Results of Parsons and Whitmore, which have been regarded as disproving the existence of solid polyiodides, are shown to be too incomplete to provide any such evidence.

Agricultural Science in Palestine

WHEN the Zionist organisation began to develop its programme for the colonisation of Palestine, it realised the need for scientific research into agriculture and horticulture and set up an experimental station at Tel Aviv under the directorship first of Dr Warburg, and now of Dr Elazari Volcani Laboratories were equipped and arrangements made for field experiments in the various parts of the country being colonised under Zionist auspices As might be expected, the scientific work has been well done and a number of interesting results have already accrued, opening up many possibilities for the future The Zionists are not the only Jewish investigators in Palestine the French organisation, known as P I C A, has its school and experimental farm at Mikveh, where good work is done, and there is, of course, the Palestinian Government Department with its headquarters at Jerusalem

The agricultural problems are those of a dry region of smallholders—a usual type of holding where irrigation can be widely practised but less common otherwise The smallholdings are necessitated by the circumstance that Palestine is only a small country, already carrying a considerable population of Arabs who have been there for many years and regard themselves as having a good claim to the land, while the number of Jews who wish to colonise it is considerable To meet the difficulty, the method was early adopted of working out schemes of husbandry suitable for small farmers of intelligence but not much capital In the Plain of Sharon, the best prospects are for fruit, flowers for scent, and, near the towns, dairy products and vegetables In the Emek these are less suitable though dairying is being seriously attempted the simple obvious products are cereals but these are not easy to sell profitably

The Tel Aviv work is based on a sufficiently comprehensive programme and it covers practically all subjects bearing upon the colonists' problems Throughout the purpose is to intensify agriculture in order to provide a higher standard of living for a larger rural population This involves the more intensive production of existing crops, the introduction of new ones, and the improvement of the native breeds of live stock At the same time, the Division of Rural Economics is making a careful survey of the conditions of production of the existing crops and live stock products with the view of further development Possibilities of disposal of the increased output are being explored the home market is not particularly large, but Egypt and the near parts of Europe offer some prospects for an export trade

Dairy farming, in particular seems to offer many advantages It gives a higher output per man and per acre than the traditional agriculture, and thus lends itself to a denser agricultural settlement The resulting animal manure raises the fertility of the soil for other systems of farming The investigation has been assisted by the Empire Marketing Board, which arranged that Mr J Crichton of the Rowett Institute, should study the subject on the spot The technical problems are well on the way to solution The grading up of the dairy cattle has been started, and also the initial improvement of the soil to a point at which it will begin to carry the new system, and the elaboration of a suitable cropping scheme The Palestinian demand for dairy produce being insufficient, it is proposed to build up a control organisation strong enough to maintain such a standard of quality as will secure the products in the overseas markets [1] The possibility of the development of a sugar industry is being examined [2] The most hopeful solution appears to be the combined cultivation of cane and beet, thus spreading the work at the factory over a longer season and broadening the scheme of cropping Sugar cane, although little grown, is not a new crop in Palestine Beet, however, presents certain difficulties in the dry regions, but these can be overcome by irrigation at critical periods

Among the indigenous plants are eight species of wild flax, and the growing of flax for seed, carried out in Bible days, is being exploited once more So far no serious diseases or pests have affected this crop, though it is anticipated that dodder is likely to put in an appearance at some future date

Palestine, however is always liable to plant diseases and pests, and steps were taken from the outset to cope with them Dr Reichert, who is in charge of the Division of Plant Pathology, and is ably assisted by Miss Hellinger, has confined his attention principally to the banana, citrus, and wheat crops 'Internal decline', a physiological disease of citrus fruits well known in other regions, has now been recorded in Palestine Diplodia stem end rot is widespread, and in 1929 cost the Palestine orange industry some £25,000 It is, however practically eliminated by debuttoning the fruit by colouring it A third trouble, due to *Sclerotinia sclerotiorum*, is common to citrus, banana, and various other crops The banana is particularly susceptible and there seems considerable danger of the spread of the fungus thence to the citrus groves The wheat studies, commenced in 1923 and still in progress, have been chiefly concerned with the relative susceptibility of different varieties to bunt, and it is of considerable interest that the wild emmer (*Triticum dicoccoides*) has been found to be highly susceptible

Dr Oppenheim, of the Division of Horticultural Breeding, is working principally upon the sugar content and the acidity of the orange fruit during its development, and upon breeding methods for improving the citrus crop He emphasises the importance of bud selection and suggests the establishment of a national organisation for the selection of stock and of bud wood from trees already existing in the groves

Of the insects giving trouble to the grower, locusts are the best known, and the Government has set up a good locust service to observe and deal with the insects as soon as they appear Other insects, however, are also harmful Dr F S Bodenheimer, in his bulletin on the Coccida or scale insects of Palestine, enumerates some 65 species, of which eight are new to science Even this list by no means exhausts the Coccid fauna and he has since issued supplementary notes He has studied also the Wood Leopard moth (*Zeuzera pyrina*), an insect which causes great damage, particularly to olive and apple trees, by its larva tunnelling in the wood The use of paradichlorbenzine or calcium cyanide is recommended as a remedy easy to handle and to apply Among other entomological papers, the report by H Haupt on *Homoptera Palestinæ* I [3] and that of F S Bodenheimer on tobacco pests may be mentioned Some of the latter originally affected wild Solanaceæ and other plants, but are now passing over to the newly planted tobacco and cause considerable injury

Spraying naturally comes in for a good deal of study one interesting paper deserves mention [4] Assuming varied standards of mortality by spraying, and a 95 per cent natural mortality in each generation of the larvæ from the eggs surviving spraying, it is shown that insects with 10 or 20 eggs per female cannot maintain their existence under such control measures, but that the Red Scale (*Chrysomphalus*

aurantii), which has 100 eggs per female, can only be controlled by a spray giving at least 90 per cent mortality, and that one, or at most two, sprayings per year are then sufficient The control measures should be applied at the time of population minimum, the numbers cannot be materially reduced if dealt with at the time of population maximum Similar considerations are applied to field mice control

The publications of the Tel Aviv Institute are not confined to agriculture and horticulture A systematic survey of the flora of Palestine is now being carried out by A Eig Two bulletins on the systematic side and one from the ecological aspect give an excellent bird's eye view of the flora of Palestine The flora is in process of active transformation owing to the effect of modern methods of land cultivation Marsh species are tending to disappear owing to increased drainage, while certain dry land species are vanishing with the spread of irrigation

The attempt to fix the shifting sand dunes will probably affect the dune flora These imminent changes render it desirable for the botanical surveys to be pushed forward as rapidly as possible but the work is handicapped by the fact that most plants are short lived appearing in the spring only so that only relatively small areas can be investigated each year The flora is much affected by physical factors especially by the distribution of rainfall, as the period of greatest heat synchronises with that of absence of rain Steps are already being taken to preserve the native flora, to guard the reserves, and to plant woods of forest trees

One of the publications makes an especially wide appeal Dr Volcani's pamphlet, "The Fellah's Farm", which, apart from its special agricultural matter, is of general interest because of its many references to survivals of ancient Jewish and fellah folklore Here for example, is a summary of the rites still performed by the local peasantry when the rain has failed to appear

"Each district has its local rites There may be a procession of girls in the twilight after the evening meal, beating empty petrol tins containing pebbles, in order to make even more noise They knock at the doors of the houses, and are sprinkled with water An old woman marches before them, a handmill on her head, on top of which a rooster shut in a basket crows lustily to call forth divine compassion A pitcher of water occasionally replaces the handmill A white cock and a black hen are carried along and beaten at intervals so that they may cry all the louder Grain and flour sifters are carried on the head to symbolise the famine threatening man and beast Sometimes an old woman, riding a donkey backwards and carrying an infant, grinds an empty handmill These figures are meant to personify innocence The old woman can no longer do wrong, while the infant has not yet tasted sin The rooster represents the domestic animals"

The workers at Tel Aviv, and the Zionist Organisation supporting them, are to be heartily congratulated on the volume and quality of the work they have already done under conditions which have sometimes been both difficult and trying With the setting up of the new experimental field at Rehovat, we may expect an even more extensive study of Palestinian problems A good beginning has been made we wish the workers all success

THE STAFF OF ROTHAMSTED
EXPERIMENTAL STATION

[1] Preliminary Report on the Agricultural Aspect of a Sugar Industry in Palestine *Tel Aviv Bull* 3 1924

[2] The Dairy Industry as a Basis for Colonisation in Palestine *Pub Palestine Econ Soc* 1928 The Transition to a Dairy Industry in Palestine *Tel Aviv Bull* 11 1930

[3] Homoptera Palestinæ I *Tel Aviv Bull* 8 1927

[4] Theoretical Considerations on the Evaluation of Control Measures, by Dr F S Bodenheimer *Hadar* vol 3 No 12 December 1930

The Satellites of Jupiter

PROF DE SITTER, Director of Leyden Observatory, delivered the George Darwin Lecture of the Royal Astronomical Society on May 8, taking as his subject "The Satellites of Jupiter" The lecture began with a sketch of the progress of our knowledge of the system Galileo attempted to make tables of their motion Romer deduced from them the finite velocity of light Wargentin devoted a large part of his life to the study of their motions Bradley made careful observations La Grange improved the mathematical theory Delambre and Damoiseau made tables, which remained in use until recent times Forty years ago, Sir David Gill carried out a series of observations with the Cape heliometer, he compared the satellites with each other, not with Jupiter itself, finding that this increased the accuracy of observation very notably The positions of certain stars had been found with great accuracy in connexion with the determination of the solar parallax from observations of the planets Iris, Victoria, and Sappho These stars were now used to check the scale of the heliometer, and this was considered to be known to one part in 100,000 Prof de Sitter took a large part in reducing these observations, he found from a combination of all determinations that the mass of the Jovian system is 1/1047 40 of the sun, with a probable error of 0 03 in the denominator

Prof de Sitter then gave an outline of the different classes of perturbations, which he divided into four groups (1) Those with periods of less than 17 days, (2) periods of 400 500 days, (3) the small libration of satellites I, II, III about their equilibrium position—he found that the period of this is close to six years, (4) those exceeding Jupiter's period of revolution The inequalities of short period exceed in magnitude the oscillations arising from the eccentricities of the orbits, he therefore used intermediary orbits based on these inequalities, instead of using ellipses

The values given by Prof de Sitter of the masses of I, II, III, IV were 381, 248, 817, and 509, expressed in units of the seventh decimal of Jupiter's mass Those of II and III are the best known the different determinations of these being very accordant He made a comparison between the Jovian system and (1) the four interior planets, (2) the four giant planets He noted that 33 years in the satellites corresponded to 17 centuries in the terrestrial planets and to 1200 centuries in the outer planets Consequently, progressive changes take place much more rapidly in the satellite system, which adds interest to the study of them

Prof de Sitter also alluded to his studies of the variations in the rate of the earth's rotation as shown by the fluctuations in the motions of the moon, the inner planets, and Jupiter's satellites Certain discrepancies between the results from Jupiter's satellites and those from the other sources suggest the possibility that the Jovian system might have fluctuations of its own He showed from a diagram that the fluctuations were small during the nineteenth century, so that it was not until the present century that their reality could be affirmed with some confidence

Newcomb had, however, suggested many years before the possibility that the lunar fluctuation might arise from changes in the earth's rate of rotation

Prof de Sitter stated that his work had been assisted by excellent series of photographs of the satellites obtained at many observatories He made a comparison between the accuracy of heliometer and photographic positions the probable error of one position with the former was 0 075″ while that from a plate with six images, measured in two positions, was 0 02″ 0 03″

Weather and Health

AN interesting report, prepared by Dr Ellsworth Huntington with the advice of a strong committee based on the daily meteorological and mortality records of the city of New York from April 15, 1882, to Mar 24 1888 appears as *Bulletin* No 75 of the National Research Council (National Academy of Sciences, Washington) Gross mortalities at ages under five years and over five years are considered separately also mortalities in these age periods from causes other than pneumonia and influenza Mortality from pneumonia and influenza (all ages) forms a separate group The data are expressed as percentages of the daily average of the particular year, and when necessary, corrections for seasonal trend are introduced For sufficient reasons, graphical methods are chiefly used, in particular climographs that is a third variable daily deaths is shown by contour lines on a bivariate diagram for example, of temperature and relative humidity It is contended that the method leads to clearer results than the use of correlation coefficients and massed averages

The principal conclusions reached are these Judging by the data of deaths from all causes except pneumonia and influenza among persons over five years of age the optimum temperature is close to 65° F Among children under five years the optimum is about 10 lower Among extremely young infants however, there is evidence that the optimum is higher So far as influenza and pneumonia are concerned it appears that the chances of contracting the disease are at a maximum with the lowest and a minimum with the highest temperatures but that the chances of death after the disease has been acquired are subject to the influence of the normal temperature optimum It appears that at the optimum temperatures, low atmospheric humidity is harmful but, among young children, plays only a minor part Above the optimum temperature, the best humidity appears to be progressively lower as the temperature rises

Much stress is put upon the relation between interdiurnal variability of temperature and mortality "No matter whether a drop of temperature causes the mean temperature to be better or worse, it tends to produce a stimulating effect which induces a relatively low death rate both on the day in question and the next day In similar fashion, no matter whether a rise of temperature brings a favourable or unfavourable mean temperature, its effect for two days is to raise the death rate" Still more interesting is the apparent fact that a moderately high degree of variability of temperature from day to day is more favourable than low variability In this respect there is a similarity between the experience of New York and of Stockholm, which suggests that there is a definite optimum variability independent of temperature

The author asks whether "the apparent difference from season to season" may not "merely represent the fact that in cold weather we are protected from changes of temperature" He finds that ideal weather in New York would be characterised by an average temperature of about 65° and a relative humidity of nearly 90 per cent The preceding ten days should have been characterised by fairly strong changes of temperature, averaging 4°, and should culminate in a fall of 10° or 12° It seems that south east England, outside the smoke laden area of London, approaches as near to the ideal as we may hope to come but the author points out that many other variables remain to be considered

University and Educational Intelligence

CAMBRIDGE —The Sadleirian professorship of pure mathematics will be vacant on Sept 30, 1931, by the resignation of Dr E W Hobson

The Appointments Committee of the faculty of mathematics has reappointed Mr S W P Steen, of Christ's College, and Mr T G Room, of St John's College to be University lecturers in the faculty, and Mr E C Bullard, of Clare College, to be University demonstrator in geodesy

A report has been received from the managers on the regulations for the Quick professorship of biology In October Prof G H F Nuttall retires from the chair after having held it for twenty five years By the terms of Mr Quick's will, the benefaction must always be used to promote 'study and research in the sciences of vegetable and animal biology" Authority is given to the managers however, to propose to the University changes in the particular field of biology with which the chair shall be associated From 1906 until 1919 this field was defined as protozoology in 1919 parasitology replaced protozoology The managers now recommend to the University that the next tenure of the Quick professorship should be associated with the field of research which they define as the study of the 'Biology of the Cell" If this recommendation is approved, they intend to offer the chair to Mr D Keilin, who has for some years been carrying on research work of this type in the Molteno Institute

The University has conferred the honorary degree of M A on Mr E Everett on his retirement, after more than forty years service from the post of assistant to Sir J J Thomson at the Cavendish Laboratory

DURHAM - The Council of Armstrong College has appointed Dr E G Richardson to be lecturer in physics Dr Richardson is at present lecturer in physics at University College London, and is engaged on research in connexion with the propagation of high frequency radiation in gases

LONDON —The London School of Economics and Political Science has been granted the sum of £142,000 by the Rockefeller Foundation This sum has been allocated as follows £60 000 for reconstructing and extending the library, £10,000 for the purchase of additional books, £30,000 towards the purchase of land for new school buildings, and £42,000, in annual grants of £6000, for providing increased facilities for post graduate teaching and research

The late Mr Clifford B Edgar has bequeathed £4000 to the London School of Hygiene and Tropical Medicine for the promotion of research Mr Edgar was a graduate of the University, and intimately connected with its work for many years, having acted as chairman of the Finance Committee from 1910 until 1920

The Court of Common Council has renewed for 1931

its grant of £105 in aid of the University's extension work, and the Drapers' Company has renewed for the year 1932 its grant of £500 for the Department of Applied Statistics at University College The Civil Service Commission has notified the University of the renewal for 1931–32 of the present subvention of £2250 from Indian revenues towards the cost of probationary instruction of selected candidates for the Indian Civil Service

OXFORD At Rhodes House, on May 9, Prof A Einstein delivered in German the first of his three Rhodes Lectures on ' The Theory of Relativity—its Formal Content and Present Problems " He gave a general exposition of the special and general theories of relativity, emphasising the need of ' logically satisfying " assumptions and explaining the methods of advance from the Euclidean to a pseudo Euclidean metric and hence to the Riemann metric The general theory could not, however, provide a logical explanation of the electromagnetic field In his second lecture, on May 16, Prof Einstein will discuss the problem of the finite universe In his last lecture, on May 23, he proposes to give an account of his attempt to derive both the gravitational and electromagnetic fields by the introduction of a directional spatial structure

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THE following courses of free public lectures in metallurgy have been arranged by the Armourers and Brasiers' Company —At 8 o'clock on May 21 and 28 and June 4, at the Royal School of Mines, 'Thin Films on Metals', by U R Evans, and at 5 30 on May 27 and June 3 and 10, at King's College, Strand, 'Some Impurities in Metals and the Production of Metals of High Purity ', by Dr W Rosenhain No tickets are required

Birthdays and Research Centres

May 18, 1873 —Dr H ELTRINGHAM, F R S president of the Entomological Society of London (1931)

Is more or less continuously engaged in the histological structure of insects, more especially that of special glands and organs At present investigating the structure of the abdominal organs in the smaller caddis flies, the action of 'diaphanol' on chitinous and other structures, and the structure of the eye in Aleurodes

At all times prepared to undertake histological investigations into the finer structure of insects, and should be glad to have unusual material for this purpose from anyone who has the opportunity of obtaining same in a proper state of preservation Would be glad to furnish suitable preservative fluids to any one who can obtain material suitable for investigations of this character

May 19, 1876 —Prof W K GREGORY, curator of the Department of Ichthyology, American Museum of Natural History

My chief investigation now in progress is the study of the skulls of fish of many orders and families Each skull is considered from two points of view first, as a natural mechanism (the inert part of a machine that serves in the complex turnover of energy taken in and paid out by the organism as a whole), secondly, as a morphological pattern, which has acquired its various characters at different stages of its phylogenetic history

I should welcome researches bearing upon the hypotheses that triradiate sutures arise through the equal growth away from each other of three centres of ossification and that the semicircular canals arose in a similar manner A functional analysis of parts of the neurocranium (cranial vault, interorbital bridge, ethmo vomer block keel bone or parasphenoid) leads to interesting results

May 23, 1850 — Dr G C DRUCE, F R S, Fielding curator in the University of Oxford

I am at present engaged in an investigation of the flora of Cyprus

May 23, 1864 —Sir ARTHUR SMITH WOODWARD, F R S, lately Keeper of the Department of Geology, British Museum (Natural History)

I have accumulated many fossil fishes on which I hope soon to continue research but I have been occupied for a long time in preparing (and largely re writing) a second English edition of Zittel's 'Palæontology ', vol 2 (Fishes, Amphibians, Reptiles, and Birds) which is now in type and nearly completed A new edition of my Outlines of Vertebrate Palæontology " will probably follow I think that one who has had long experience of any sphere of research can do good service to science by attempting, from time to time, to digest and correlate the results of the multitude of technical papers and memoirs which now appear in more rapid succession than ever

Societies and Academies

LONDON

Royal Society, April 30[1] – **J A Todd** On twisted cubic curves which satisfy twelve conditions The paper deals with the problem of determining the number of twisted cubic curves in space which satisfy the joint condition of meeting r lines in one point s lines in two points, and of passing through t fixed points where $r+s+2t=12$, so that the condition determines a finite number of curves The simpler cases are treated by a variety of elementary methods, for the more complicated cases the principle of special position is employed in which the given lines and points are made to assume particular positions in such a manner that the curves which are required fall into various classes of which the number of curves in each is determined by simpler considerations — **H T Flint** A metrical theory and its relation to the charges and masses of the electron and proton This paper points out the analogy existing between the equations of the quantum theory and the electromagnetic equations of Maxwell, pointing to the existence of a definite natural metric in a five dimensional continuum Parallel displacements along the world lines in this continuum are associated with no change in length but in the four dimensional world the change of length is a periodic function with a frequency proportional to the mass associated with the world line This view leads at once to the interpretation of the ratio of the masses of the electron proton as a metrical ratio, and makes a unitary physical theory possible —**A M Mosharrafa** Material and radiational waves The Maxwellian equations of electromagnetic and electron theory are derived from one set of basic relations in a manner which throws some light on the relationship between material and radiational waves, and accounts for the existence of exactly three types of physical entities, namely positive electricity negative electricity, and radiation It is shown that a physical entity may be associated with the propagation of a vector A in a direction n If A and n are in the same direction, the entity is recognised

[1] Continued from p 726

as positive electricity, if in opposite directions as negative electricity, and if mutually perpendicular, then as radiation In the general case, A will have both a longitudinal and a transverse component, corresponding to the co existence of matter and radiation — **J Guild** The colorimetric properties of the spectrum The paper describes an investigation carried out at the National Physical Laboratory to determine the colorimetric properties of a group of seven subjects as obtained from direct measurements of the trichromatic coefficients of the spectrum on a trichromatic colorimeter A proposal is made for the adoption of a set of standard data, to represent a normal eye for technical colorimetric purposes, based on the results of this investigation and those recently published by W D Wright —**C Robinson** and **H A T Mills** The colloid chemistry of dyes The aqueous solutions of benzopurpurine $4B$ and its isomer prepared from m tolidine (1, 2) Although benzopurpurine $4B$ is a well known cotton substantive dye, its isomer prepared from m tolidine has not sufficient affinity for cotton for it to be of practical use as a dye stuff An investigation of the solutions of these dye stuffs has been carried out in order to see if correspondingly great differences could be found in their colloidal properties The viscosity of their solutions (if not super saturated) are the same and are of the order to be expected in an unhydrated colloid The viscosity does not vary with rate of shear, and the conductivities are of the same order On the other hand, ultra filtration, flocculation by electrolytes, and ultra microscopic examination show marked differences between the two dyes which may be explained if it is assumed that benzopurpurine $4B$ forms larger aggregates than the meta isomer The osmotic pressures of the two dyes are almost the same, this can be accounted for in spite of the difference in particle size shown by experiments described It is concluded that these dyes exist in solution as totally dissociated colloidal electrolytes, hydrolysis being negligible —**G B Deodhar** X ray nondiagram lines In the K and L series, nondiagram lines pairs are found which show approximately constant $\sqrt{\nu/R}$ differences These seem to resemble the usual screening doublets —**T E Stern** The chemical constant of chlorine vapour and the entropy of crystalline chlorine By statistical mechanics the molecular composition of chlorine gas is calculated, assuming that the ratio between the numbers of atoms of the two isotopes 35 and 37 is known It is found in this calculation that the angular momenta of nuclei are without effect upon the constitution of chlorine gas The vapour pressure of chlorine crystals is also calculated and, finally, the entropy of chlorine per mole in the crystalline form at the absolute zero **I E Knaggs** The molecular symmetry of hexa amminobenzene in the crystalline state and certain other properties of the substance An examination of crystals of hexa aminobenzene by the powder X ray photographic method has shown the crystal symmetry to be that of the holohedral cubic class, the space group being O_h^2 There are 16 molecules in the unit cell of side 15 14 A, and the molecules possess a threefold axis of symmetry —**H W Melville** and **E B Ludlam** The effect of foreign gases on the lower critical oxidation limit of phosphorus vapour The experiments were carried out to test the equation originally proposed by Semenoff In the present approximate state of the theory, the differences obtained are explained on the variation of the diffusion coefficient of the chain propagators into the foreign gas The results show no correlation with those obtained for foreign gases at the upper critical oxidation limit —**L Rosenhead** The lift on a flat plate between parallel walls The effect of the walls is to increase the lift-coefficient, and curves and tables are given showing this increase for various values of the angle of attack and the ratio of chord of aerofoil to width of channel —**J A V Butler** and **A D Lees** The behaviour of electrolytes in mixed solvents (3) The molecular refractivities and partial molar volumes of lithium chloride have been determined in a series of mixed water alcohol solvents It is found that the molecular refractivity is constant in each solvent over the range of concentrations investigated Its value is scarcely affected by the presence of alcohol until the molar fraction of the latter is more than 20 per cent, and then falls off steadily to the value for pure alcohol The effect of lithium chloride on the density of the solutions varies greatly with the composition of the solvent —**T C Marwick** An X ray study of mannitol, dulcitol, and mannose The relationship is traced between the structures of mannitol and dulcitol, and between the structures of mannose and other saccharides (See also NATURE, Jan 3, 1931, p 11)—**G I Finch** and **J C Stimpson** The electrical condition of hot surfaces during the adsorption of gases The electrical conditions of a carbon rod and a copper sheet have been studied at temperatures up to 850° C *in vacuo*, and in contact with various gases The results of these experiments suggest that 'normalisation' of the carbon involves the evolution of occluded gases accompanied by structural changes in the surface, but that in the case of copper it involves a process of sintering —**A B D Cassie** and **C R Bailey** Investigations in the infra red region of the spectrum (3, 4) The absorption spectrum of carbon disulphide is described between the limits of 1 μ and 22 μ, and the results compared with those of Coblentz for the liquid The molecule possesses a rectilinear structure, with probably a single linkage between the carbon and sulphur atoms The Raman spectrum has been co ordinated with the infra red spectrum, and an explanation is offered for the appearance in both of the characteristic doublet associated with the inactive frequency —**D R M'Rae** Asymmetry observed in the stark component of H_α A special grating having a very intense first order spectrum on one side has been used to resolve the Stark components of H_α Asymmetry is observed in the displacements of the components, and also in the relative intensities of the components Altering the number of atoms in the initial states does not explain completely the asymmetry of intensities —**F D Miles** The apparent hemihedrism of crystals of lead chloride and some other salts Lead chloride, which normally shows holohedral orthorhombic symmetry, can, under certain specified conditions, be obtained from hot solutions containing dextrine in microscopic crystals consisting of a single form (a bisphenoid), which can have only axial symmetry By reducing the concentration of dextrine this form can be gradually repressed Normal crystals of lead chloride were grown and investigated by X ray methods The difficulty of X ray work with crystals impervious to the radiation is emphasised, and a simple method is given for finding whether any given reflection will emerge from any crystal face The structure contains two glide planes of symmetry The symmetry is, therefore, in all probability holohedral The idea that crystal faces lying opposite to each other across a plane of symmetry may behave differently to an optically active reagent is supported The cases described appear to be the first to demonstrate that the presence of optically active material may induce the *growth* of a hemihedral crystal of a substance, the normal symmetry of which is certainly higher —**C E Wynn-Williams** The use of thyratrons for high speed automatic counting of physical phenomena The thyratron may be regarded as a triode valve which

contains a trace of mercury vapour or inert gas at low pressure Under appropriate conditions, a positive voltage impulse of only a few micro seconds' duration applied to the grid will cause an arc to strike between the anode and cathode (or filament) The arc then continues independently of further grid potential changes until the anode circuit is momentarily inter rupted In this respect the thyratron behaves as a very delicate, inertialess relay, capable of controlling considerable currents Some circuits are described for utilising to the greatest advantage the 'inertia less relay' characteristic of the thyratron, for high speed automatic counting of voltage impulses set up by physical phenomena Two impulses separated by as little as 1/500th second can be separately recorded

PARIS

Academy of Sciences, Mar 30—**Camille Matignon** Some properties of commercial calcium nitrates These have been regarded by some people as liable to spontaneous combustion, and some insurance companies have enforced special premiums on this account It is shown experimentally that these views are erroneous—**Gabriel Bertrand** and **V Ciurea** Tin in the animal organism Previous work on this sub ject is criticised on the ground that the method em ployed did not differentiate tin from silica The authors, using a more exact method have found in the organs of the ox, horse, and sheep quantities of tin varying between 0 4 and 26 parts per million, the largest proportions being found in the tongue no tin was found in the peritoneum—**André Blondel** The limitations of photometry—**Léon Guillet** and **Jean Cournot** Remarks relating to the influence of occluded gases on the mechanical properties of metal lurgical products Criticisms of the conclusions of Guichard, Clausmann, Billon, and Lanthony on the effect of occluded gases on the hardness of electrolytic iron—**D Wolkowitsch** The representation of the results of a series of experiments by an approximate formula with two parameters—**Paul Delens** Con gruences of curves and figuration of invariants—**D Pompeiu** The property of holomorph functions—**A Magnan** and **A Sainte-Laguë** The distribution of aerodynamic velocities round an aeroplane in flight—**L Joly** A method of measuring the heat conduc tivity coefficient of materials—**Guy Emschwiller** The chemical action of ultra violet light on the alkyl iodides From a study of the action of ultra violet light on liquid alkyl iodides, it is concluded that the primary action is removal of a molecule of hydrogen iodide, this can react with another molecule of the iodide, giving a saturated hydrocarbon and iodine The other secondary products found can also be ex plained on this hypothesis—**Ch Bedel** The electri cal resistance of silicon It has been found possible to secure good electrical contacts with pure silicon, and obtain consistent figures The presence of small proportions of iron in the silicon has a marked effect on the resistance—**R Gibrat** The optics of uniaxial heterogeneous structures—**H Le Breton** The age of the recent marine terraces of Xu Nghé in North Annam (French Indo China)—**D Chalonge** and **E Dubois** The distribution of ozone in the atmosphere From the study of absorption spectra it is concluded that ozone is distributed in the atmosphere in a much less discontinuous manner than has hitherto been supposed, there are appreciable quantities at relatively low altitudes—**Mme F Bayard-Duclaux** The elec trical conductivity of the air at Paris—**Pierre Lesne** Organic adaptation in xylophage insects of the family of the Bostrychidae Commensalism of Lyctoderma—**Mme Lucie Randoin** and **René Fabre** Comparative researches on the proportion of SH derivatives in striated muscle, liver, and blood in the normal rat, in the underfed rat, and in the rat deprived of the B vitamins—**J Lefèvre** and **A Auguet** The problem of the relationship between the heats of work and repose The solution and laws Why work is more economi cal at low temperatures—**Ch Hruska** Vaccination against anthrax with non attenuated virus Saponin is added to the virus and this is injected The local swelling is cured in 15-20 days, and the animal is re sistant to infection The mixture of the virus and saponin is unaltered after keeping for fifteen months

Official Publications Received

BRITISH

Scientific Reports of the Imperial Institute of Agricultural Research Pusa, (including the Reports of the Imperial Dairy Expert Physiological Chemist Government Sugarcane Expert and Secretary Sugar Bureau) 1929-30 Pp vi+165 (Calcutta Government of India Central Publication Branch) 3 8 rupees 6s

The Indian Forest Records Chemistry Series Vol 16 Part 2 Indian Ephedras By Dr S Krishna and T P Ghose Pp ii+82+5 plates (Calcutta Government of India Central Publication Branch) 1 14 rupees 3s 3d

Agriculture and Live stock in India Vol 1, Part 1 January Pp. xii+108+6 plates (Calcutta Government of India Central Publication Branch) 1 8 rupees 2s 6d

The Indian Journal of Agricultural Science Vol 1 Part 1, February Pp vi+156+15 plates (Calcutta Government of India Central Publication Branch) 2 8 rupees, 4s 6d

Report of the Kodaikanal Observatory for the Year 1930 Pp ii+4 (Calcutta Government of India Central Publication Branch) 6 annas

Government of India Department of Industries and Labour Functions and Organisation of the India Meteorological Department (1931) Pp 18 (Delhi Government of India Press)

Proceedings of the West Indian Conference of Agricultural Officers 1930 held at the Imperial College of Tropical Agriculture, Trinidad B W I on the 23rd January 1930 and following Days Pp 56 (Trinidad Government Printing Office) 2s net

Mysore Geological Department Bulletin No 11 Review of Mineral Production of Mysore for 1915 to 1929 By A M Sen Pp xiv+203+4 plates (Bangalore Government Press) 8 rupees

Silvicultural Research Manual for use in India Vol 2 Statistical Research (The Statistical Code) By H G Champion and I D Mahendru Pp viii+204+10 plates (Calcutta Government of India Central Publication Branch) 12 10 rupees 20s 6d

Journal of the Royal Microscopical Society Series 3, Vol 51, Part 1, March Pp xvi+108 (London) 10s net

Madras Fisheries Department Fish Statistics for 1926-27 (Supplement to the Administration Report for 1927-28) Edited by Dr B Sundara Raj (Report No 2 of 1929 Madras Fisheries Bulletin Vol 23) Pp 87 151 (Madras Government Press) 10 annas

FOREIGN

Memorie del R Istituto Lombardo di Scienze e Lettere Vol 24 Fascicolo 2 Pier Candido Decembrio, contributo alla Storia dell Umanesimo Italiano Memoria di Ernst Ditt Pp 21 108 (Milano Ulrico Hoepli) 22 lire.

Rendiconti del Seminario Matematico e Fisico di Milano Vol 4 (1930 VIII). Pp xi+236 (Milano)

Smithsonian Institution Bureau of American Ethnology Bulletin 97 The Kamia of Imperial Valley By E W Gifford Pp. vii+94+2 plates (Washington D C Government Printing Office) 25 cents.

The World Calendar By Elisabeth Achelis Second edition Pp 20 (New York City The World Calendar Association Inc)

Pubblicazioni del R. Osservatorio Astronomico di Merate (Como) succursale del R Osservatorio di Brera (Milano). N 4 Ricerche sulla frequenza delle grandezze assolute delle stelle delle diverse classi spettrali Per Gino Cecchini Parte I Catalogo generale di parallassi stellari Pp 152 (Milano Ulrico Hoepli) 30 lire

Conseil Permanent International pour l Exploration de la Mer Bulletin trimestriel des résultats acquis pendant les croisieres périodiques et dans les périodes intermédiaires Publié par le Bureau du Conseil avec l assistance de C H Ostenfeld Résumé des observations sur le plankton des mers explorées par le Conseil pendant les années 1902-1908 Quatrieme partie Sommaire général des parties 1 à 3 Pp 601 672 (Copenhague Andr Fred Høst et fils)

Proceedings of the United States National Museum Vol 78 Art 21 Description of a New Species of Amidostomine Worm of the Genus Epomidiostomum from the Gizzard of Anserine Birds By Rudolf Wetzel (No. 2864) Pp. 10+2 plates (Washington, D C Government Printing Office.)

CATALOGUES

Nickel Alloy Steels a Summary of their Properties and Applications (Nickel, A7) Pp 12 (London The Mond Nickel Co Ltd)

Spectrometric Apparatus (Spectrographs) Pp. 16 (London Bellingham and Stanley, Ltd)

New Books at Reduced Prices in various Subjects (No 457) Pp 44 (Cambridge Bowes and Bowes)

New Models (Catalogue No T L 20) Pp 19 (London The Medical Supply Association Ltd)

Fungi Plant Pathology, etc. Catalogue of the Library of the late Dr N Patouillard (Catalogue No 186) Pp 32 (London Dulau and Co Ltd)

Diary of Societies

FRIDAY, May 15

Royal College of Surgeons of England, at 4 —Sir Arthur Keith Human Monsters and Malformations (6) A Consideration of the Commoner Malformations to ascertain how far they can be explained by regarding them as Atavistic States or as due to Parental Influences

Royal Society of Arts (Indian Section), at 4 30 —F S Grimston The Indian Ordnance Factories and their Influence on Industry

British Institute of Radiology (Medical Meeting) at 5

Physical Society (at Science Museum South Kensington) at 5 15 Sir Richard T Glazebrook Standards of Measurement their History and Development (Guthrie Lecture)

Institute of Chemistry (Belfast and District Section) (at Royal Belfast Academical Institution) at 7 30 —Annual General Meeting

Royal Society of Medicine (Obstetrics and Gynæcology Section) (Annual General Meeting), at 8 The Relative Value of the Induction of Premature Labour Test Labour and Cæsarean Section in the Treatment of Minor Degrees of Contracted Pelvis

Royal Institution of Great Britain at 9 —Prof J C Philip Experimental Aspects of Hydrogen Ion Concentration

SATURDAY May 16

Institution of Municipal and County Engineers (Southern District Meeting) (at Cheltenham) at 10 30 A M

Biochemical Society (in Department of Biochemistry Oxford) at 2 30 —Dr I S Maclean and M S B Pearce Oxidation of Oleic Acid *in vitro* and their Bearing on the Biological Oxidation of Oleic Acid —J A Lovern and R A Morton Pigmentation in the Livers of Monk Fish —J A Lovern R H Creed, and R A Morton The Mittelmann Process for Treating Fish Livers —A E Gillam and R A Morton The Antimony Trichloride Colour Test and the Ultra violet Absorption of Liver Oils and Concentrates —Prof I M Heilbron, A E Gillam, and R A Morton Specificity in Tests for Vitamin A A New Conception of the Chromogenic Constituents of Fresh and Aged Liver Oils —K H Coward K M Key B Morgan, F Dyer, and R A Morton Biological, Chemical and Physical Measurements of Vitamin A —A L Bacharach E Allchorne, and V Hazley The Effect of Adding Vitamin A to a Rachitogenic Diet —Prof J C Drummond and B Ahmad Observations on the Relations between Carotene and Vitamin A —T W B Osborn Influence of Various Factors on the Concentration of Complement in Blood —C L Cope Creatinine Excretion in Man —R B Fisher Relation of Lactic Acid Metabolism to Avian Polyneuritis —N Gavrilescu and R A Peters Tissue Respiration in Vitamin B Deficiency —Prof R A Peters Tension Buffering —H W Kinnersley and Prof R A Peters Observations on the Thermolability of Vitamin B_3 —A S Foot J Golding and S K Kon Note on the Requirements of the Pig for the Vitamin B Complex —R Cook and Prof J B S Haldane The Respiration of Bacterium Coli D C Harrison Glucose Dehydrogenase a New Oxidising Enzyme from Animal Tissues O Rosenheim and W W Starling Note on the Purification and the Optical Activity of Carotene —H J Phelps and R B Vallender Further Observations on the Equilibria set up at a Charcoal Water Interface —Demonstration T W B Osborn Method of Estimating the Blood Complement

MONDAY May 18

Victoria Institute (at Central Buildings, S W 1) at 4 30 —Dr C E P Brooks Climatic Changes since the Ice Age

Royal College of Surgeons of England at 5 —Col R McCarrison Experimental Research at the Pasteur Institute Coonoor S India (1)

Royal Society of Medicine (Odontology Section) (Annual General Meeting) (at Royal College of Surgeons) at 8 —Dr E W Fish An International Nomenclature of the so called Pyorrhœa Group of Diseases

Royal Geographical Society at 8 30 —B Thomas The First Crossing of the Rub Al Khali

TUESDAY May 19

Royal Society of Edinburgh, at 4 30 —Prof A D Peacock and Dr R A R Gresson Male Haploidy and Female Diploidy in *Sirex cyaneus*, F (Hymen) —Miss J A R Wilson Some New Facts about the Structure of the Russian Paper Coal Cuticles, and their Bearing on the Systematic Position of some Fossil Lycopodiales with a Note on the Absence of Eligulate Heterosporous Lycopodiales in the Fossil record by Prof J Walton —A H R Goldie The Electric Field in Terrestrial Magnetic Storms —Prof T M MacRobert Fourier Integrals

Royal Statistical Society (at Royal Society of Arts) at 5 15 —Dr E C Rhodes Labour and Output in the Coal Mining Industry in Great Britain

Royal Society of Medicine, at 5 30 —General Meeting

Institute of Industrial Administration (at Institute of Hygiene) at 6 30 —T G Rose Higher Control (Lecture)

Royal Anthropological Institute, at 8 30 —Dr S K Hutton The Labrador Eskimos, Past and Present

WEDNESDAY May 20

Society of Glass Technology (in London), at 2

Royal Meteorological Society at 5 —Sir Gilbert Walker Recent Work by S Mal on the Forms of Stratified Clouds —C K M Douglas A Problem of the General Circulation —G S P Heywood Wind Structure near the Ground, and its Relation to Temperature Gradient

Royal College of Surgeons of England, at 5 —Col R McCarrison Experimental Research at the Pasteur Institute Coonoor S India (2)

Geological Society of London, at 5 30 —Dr A A Fitch The Geology of the Country between Ivybridge and Buckfastleigh, Devon —Exhibition of a Series of Specimens illustrating the Contact metamorphic Effects of a Diabase Sill, at New Hope, Bucks County, Pennsylvania

Royal Microscopical Society (at B M A House), at 5 30 —Dr C A Hoare Transmission of Trypanosomes by Insects —Prof D L Mackinnon Lancaster s Gregarine from the Eggs of *Thalassema neptuni* —Dr F Davies The Conducting System of the Heart —Prof R Ruggles Gates A Double Zygospore in Spirogyra

Folk Lore Society (at University College), at 8 —Prof R A Nicholson Some Notes on Persian and Arabian Folklore

THURSDAY, May 21

Royal Society of Medicine (Dermatology Section), at 5 —Annual General Meeting

Institution of Mining and Metallurgy (at Geological Society) at 5 30

Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College, Dublin) at 7 45 —Annual General Meeting

Chemical Society, at 8 G M Bennett and F S Statham (a) Stereoisomerism of Disulphoxides and Related Substances Part VII Some Further Pairs of Isomeric Dioxides, (b) Part VIII Isomeric Tetrabromides of a Disulphide G M Bennett and W B Waddington Studies in the Penthian Series Part IV The Four Stereoisomeric Oxides of Benzoylaminobenzpenthiene —G M Bennett and A N Mosses Derivatives of the Aliphatic Glycols Part III Chlorohydrins of some Higher Glycols —G M Bennett and A N Mosses The Influence of the Sulphur Atom on the Reactivity of Adjacent Atoms or Groups Part V Comparative Reactivities of Nine Homologous Phenyl ω hydroxyalkyl Sulphides with Hydrobromic Acid

Royal Society of Tropical Medicine and Hygiene (at 11 Chandos Street W 1), at 8 15 —Dr G W M Findlay Infectious Jaundice

Coke Oven Managers Association (Northern Section) (at Armstrong College Newcastle upon Tyne) —Dr J H Jones Reactivity of Coke

FRIDAY May 22

Institution of Electrical Engineers (London Students Section) (*Annual General Meeting*) at 6 15 Exhibition of a Cinematograph Film The Story of Bakelite Resinoid

Society of Chemical Industry (Newcastle Section) (at Armstrong College Newcastle upon Tyne) at 7 30 —Dr J T Dunn Chairman s Address

Royal Institution of Great Britain, at 9 —Sir William Bragg X Ray Investigations of the Structure of Liquids

PUBLIC LECTURES

FRIDAY, May 15

London School of Economics at 5 —Lord Lugard of Abinger British Rule in Tropical Africa (Succeeding Lectures on May 18 and 19)

London School of Hygiene and Tropical Medicine (Public Health Division) at 5 —Prof E L Collis Industrial Hygiene Respiratory Diseases

Imperial College—Royal School of Mines at 5 30 —Dr H de Böckh Selected Chapters of Regional Geology and Tectonics (Succeeding Lectures on May 19 and 21)

King s College, London at 5 30 —Col the Master of Sempill Air Communications of the British Empire

Institution of Mechanical Engineers at 8 —Prof E L Collis The Coal Miner His Health and Occupational Diseases (1) Environment of Work (Chadwick Lecture)

MONDAY, May 18

Institution of Mechanical Engineers at 8 —Prof E L Collis The Coal Miner His Health and Occupational Diseases (2) Welfare—the Fund (Chadwick Lecture)

TUESDAY, May 19

Institute of Physics (at Institution of Electrical Engineers) at 4 30 —A E L Chorlton Physics in Relation to the Development of the Internal Combustion Engine (Public Lecture on Physics in Industry)

Institute of Pathology and Research (St Mary s Hospital W 2) at 5 —Prof J Mellanby Recent Work on Blood Coagulation

WEDNESDAY May 20

London School of Hygiene and Tropical Medicine (Public Health Division) at 5 —Dr B Hart Mental Hygiene

THURSDAY May 21

University College London, at 2 30 —Sir Flinders Petrie The City of the Shepherd Kings

Royal School of Mines at 8 —U R Evans Thin Films on Metals (Armourers and Brasiers Company Lectures) (Succeeding Lectures on May 28 and June 4)

FRIDAY, May 22

London School of Hygiene and Tropical Medicine (Public Health Division) at 5 —Prof E L Collis Industrial Hygiene Respiratory Diseases

Birkbeck College, at 5 30 —Sir Henry Hadow The Philosophy of Lord Haldane (Haldane Memorial Lecture)

CONGRESS

May 19 to May 24

Royal Institute of Public Health (at Frankfort-on Main) —In Six Sections as follow

(1) State Medicine and Municipal Hygiene
(2) Architecture Housing, and Town planning
(3) Industrial Hygiene
(4) Women and Children and the Public Health
(5) Tuberculosis
(6) Pathology, Bacteriology, and Biochemistry

SATURDAY, MAY 23, 1931

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No 3212 Vol 127]

The Scientific Worker in State Service

THE not wholly admirable human instinct for individual self preservation has given to the technical expert in medicine and surgery an impressively high status in the community A corresponding instinct for communal self preservation has combined with still less admirable instincts to maintain a high status for the technical expert in the warlike arts It is significant of the haphazard organisation of the human community that these emergency experts concerned with the pathological processes of individual or political life should hold a status not generally accorded to those technical experts who devote their not inferior knowledge and skill to the daily non pathological processes of a modern civilisation

The British Science Guild has added to its considerable public services by publishing the report of a committee which has since 1927 been inquiring into the functions of the scientific and professional staffs in the Public Services and Industry from the point of view of efficient administration and national development * The report is perhaps necessarily restricted to conditions in Great Britain and to the special classes of scientific and professional staffs which might have been more closely described as physicist chemist and engineer classes There is no reference to the biologist whose claim to improved status has been conceded only in pathological emergency —the entomologist for example has climbed to power by the ladder of fear which served the warrior and the medicine man The restriction of the field of survey to particular professional classes does little harm but the most superficial knowledge of conditions in Germany and the United States suffices to suggest that the other restriction should be removed by extending the survey to these countries The Engineer who became a Bank Vice President is an American story with a moral for the British reader which might profitably be written by the Guild it is far more significant than the better known story of the engineer who became Federal President If no other assault on the British art of improvisation avails the fear motive will eventually be effective in widening the sphere of influence opened to the technical expert When pathological processes are sufficiently obviously established in the industrial organism the industrial pathologist will be given the wide powers which should have been his as a

* A Report on the Scientific and Professional Staffs in the Public Services and Industry Prepared by the Committee on the Position of the Technical Expert in the Public Services and Industry Pp vi + 62 (London British Science Guild 1931) 1s

directing physiologist, powers which are already accorded in the competing industries of other countries

The committee indicates its awareness of this international contrast in a single sentence "It can hardly be doubted that the contrast admittedly existing between the high *average* modernity of industrial plants in America, Germany, and France and the number of relatively obsolete plants in this country, is attributable in no small degree to the fact that British technicians in many undertakings have been denied the opportunity to influence policy to the same extent as in the countries mentioned"

The report surveys the position of the scientific and professional worker in the local government service, the Civil Service, the forces of the Crown, and in industry, not from the point of view of conditions of service as affecting the individual, but from that of efficiency in the services and in industry It is concluded that neither in industry nor in the public service are the requirements fulfilled, in every case, for close collaboration on the part of the scientist or the technologist, the financial adviser, and the administrative chief', nor for "the proper presentation of the various technical, financial, and other considerations involved in every problem, in such a manner that those ultimately responsible for making decisions may be put in a position to weigh the several considerations in their bearing upon questions of general policy" The local government services are regarded by the committee as making better use of their scientific and professional staffs than do the other organisations considered, the Civil Service, with few exceptions, is regarded as the least satisfactory part of the field surveyed

This criticism of the national services is opportune The provision for the very wide range of scientific and technical work now undertaken by the State has been subject to intense criticism and investigation throughout the last few years A subcommittee of the Committee of Civil Research was appointed, in 1926, "to consider the co ordination of research work carried on by or under the Government, to report whether any further measures should be taken to prevent overlapping, to increase economy and efficiency, and to promote the application of the results obtained" In a report published in 1928 this 'Ormsby-Gore sub-committee' discussed the scientific services of the Government from the point of view of function and organisation without including recommendations for their improvement That recommendations were made, although not published, may be inferred from the report for the year 1928-29 of the Committee of the Privy Council for Scientific and Industrial Research ("In due course the sub-committee recommended, amongst other things, that ")

The recent Treasury committee on the staffs of Government scientific establishments had before it an outline, submitted by the Institution of Professional Civil Servants, for the radical reorganisation of scientific public services That committee, however, stated in its report (1930) that "The respective functions of the establishments within our terms of reference have recently been set out in considerable detail in the Report of the Research Co ordination Sub Committee of the Committee of Civil Research and we have assumed the first part of our terms of reference to be an instruction, not to criticise and report on those functions, but to take note of them as the basis of our investigation into the conditions of service of the staffs employed The Association of Scientific Workers submitted a generally similar scheme of reorganisation in its evidence to the Royal Commission on the Civil Service, now sitting The Commission, in turn, has declared itself unwilling to add to its herculean labours by considering proposals involving substantial modifications of departmental structure

The British Science Guild's Committee finds that, "The evidence which has been obtained by us shows that, as a general rule, the position of the scientific and technical staffs in the Home Civil Service is most unsatisfactory, and that, in the interests of efficient administration and national development, drastic reforms are needed in the organisation of many of the civil departments of the Government In order that the scientific and technical staffs should exercise their function properly it is imperative that the position occupied by the Minister of a civil department should be altered to accord with present day requirements, and further, that the responsibilities of the scientific and technical staffs in relation to the Minister should be clearly and specifically prescribed The heads of the scientific and technical departments should, it is submitted, be colleagues of, and be equal in status with, the permanent heads of departments, and not subordinates under a secretariat or similar body" The committee then proceeds to make suggestions for modernisation of the system

It may be that this increasing body of constructive criticism is misdirected It may be that Sir Holberry Mensforth's advice is of greater weight It may be that "The thing to do with these men is to lock them up in a room and feed them through a pigeon hole, you must not let them loose in your

organisation" But sentence of solitary confinement should be passed only by a balanced, fully informed, and fully authoritative tribunal, the full-bottomed wig would certainly be, the black cap might be, more appropriate head-dress for the occasion than are the cap and bells donned by Sir Holberry Mensforth

It is to be regretted that the Ormsby-Gore recommendations, on which the scientific services of the State must be assumed to operate at the moment, have not been communicated to the scientific world at large, also that a relatively large amount of attention has been given and is being given to merely subsidiary questions of the labels and rewards attached to the conduct of the scientific work of the State Examination of these matters was urgently necessary, and the recommendations of the Carpenter Committee are valuable and most welcome contributions to economy and efficiency So long, however, as the major issue is shirked, so long as those responsible for the organisation of scientific work for the State fail to take the scientific world into their confidence, so long as full inquiry into the best methods for ensuring the most economical and effective conduct of the technical work of the State—without undue tenderness about departmental structure—is delayed, just so long will improvisation, sometimes inspired, continue to bear its meagre fruit

The Charm of the Alps

The High Alps a Natural History of Ice and Snow By Dr A E H Tutton Cheaper edition Pp xvi + 319 + 48 plates (London Kegan Paul and Co, Ltd, 1931) 10*s* 6*d* net

DR TUTTON'S book is written by a lover of mountains for those who desire to know more about the ice and snow which they meet on glacier expeditions, and about the nature and causes of the glaciers themselves The first part of the book contains a good popular description of the physics and chemistry of water, snow, and ice It leads naturally to a second part in which snow and ice are considered in the mass, as they occur upon high mountains This second part includes an excellent, and not too long, account of the development of the theory of glacier movement (and interesting information concerning recent variations in mass of the glaciers), and a chapter on glacier phenomena—moraines, crevasses, and lakes—all treated in a simple manner An account of scientific work upon Mont Blanc, and the story of the Mont Blanc observatories, which find place in the third part of the book, might perhaps have been more logically placed in the second part The story of the Mont Blanc observatories is of particular interest, as it is abstracted from an account written for the author by M Joseph Vallot himself shortly before his death A topographical description of the chief mountain groups of the Alps might perhaps more logically have been placed in the third part of the book than in the second, which concludes with a brief historical sketch of the conquest of the great alpine summits

Even if the reader had not already been warned by the profuse illustrations of mountain scenery (more than 150 in number, and to be criticised only on account of their small size—would that they had been larger!), he will find in the second part of the book that Dr Tutton's real interest and enthusiasm lie in mountain expeditions and, particularly, in the views of the mountains which they afford In this, Dr Tutton carries on an illustrious tradition It is curious how great has been the attraction of mountains for men of science both in Great Britain and abroad H B de Saussure's encouragement of the first ascent of Mont Blanc in 1786, and his own ascent in the following year, are well known, but before that ascent he had spent many summers wandering in almost unknown alpine valleys Of our own countrymen, Beaufoy (who climbed Mont Blanc a few days after Saussure) was a fellow of the Royal Society —as, of course, were Sir John Herschel (Breithorn, 1822) and J D Forbes In later times, one in every twenty of the first three hundred members of the Alpine Club was, or was to become, a fellow of the Royal Society

Forbes's 'Travels in the Alps' is as much a record of mountain exploration as of his observations of glacier movement It, and the "Tour of Mont Blanc" (1845), in which he republished the account of his expeditions, played a part in the development of mountaineering which is difficult to exaggerate When Hudson and Kennedy and their companions made the 'guideless' ascent of Mont Blanc from St Gervais, in 1855, they carried a map taken out of one or other of these books—and that ascent was the true commencement of modern mountaineering

Modern climbing has developed a technique which would scarcely be recognised by the pioneers, but Dr Tutton points out with truth the catholic nature of the attraction which mountains have for different men If the great ice faces and steep ridges which are climbed to day have their own strong attraction, that does not compete with

the equal attractions of a high glacier pass such as the Col du Géant, or of a walk along a valley path Scenery is, and must remain, one of the chief motives of a mountain walk—whether that be a high or a low one, and the author is right where he says that the best mountain views are often to be obtained from the middle heights

The third part of Dr Tutton's book is of value and much interest We have our Murrays and Baedekers on one hand and our climbing guide-books on the other, but here is something novel, and differing from both In it Dr Tutton gives us an account of some of his own expeditions framed as a sort of guide book of glacier passes The treatment is topographical, and he has so selected his material that all the expeditions are within the compass of a moderate walker, while none is dangerous In particular, he is careful to mention good view points, and to describe the views met in the course of the expeditions What is better still, he illustrates these with his own camera It is impossible not to understand and feel Dr Tutton's own enthusiasm for mountain scenery when reading this last part of his book, and the book may be recommended not only to those who have walked in the Alps and would like to know more about the glaciers which they have crossed, but also to those who have never been there and would like to know wherein the attraction consists

Those of us who have climbed in the Alps are often asked to do the impossible—to explain our motives There is only one reply—" Go and see for yourself " But how is it to be done? This book may perhaps solve the problem for some It is not difficult to select from it a series of expeditions which would comfortably fill a holiday and serve as an introduction to the regions above the snow line

Genius-Hunting

Genetic Studies of Genius Vol 3 *The Promise of Youth Follow up Studies of a Thousand Gifted Children* By Barbara Stoddard Burks, Dortha Williams Jensen, Lewis M Terman, assisted by Alice M Leahy, Helen Marshall, Melita H Oden Pp xiv + 508 (Stanford University, Cal Stanford University Press, London, Calcutta and Sydney George G Harrap and Co, Ltd, 1930) 21s net

IF we allow one developed 'genius' to 100,000 children born (which is a liberal allowance), what is the chance that in the 250,000 Californian children, corresponding to 2 5 adult geniuses, one of these will have been picked out in the five or six hundred gifted children now remaining out of those selected in 1921–22 by the fact of their intelligence quotients (*I Q*'s) being 140 or above? Supposing one such should occur, shall we be able to differentiate him from the remaining 500 gifted children by the surprising record of facts concerning these children accumulated by Prof Terman and his colleagues? We scarcely imagine that a Shakespeare, a Beethoven, or a Rembrandt would have been associated with a high intelligence quotient when six to eight years of age It would seem to us that a more fitting title for this work would be " An investigation as to whether the promise of childhood is fulfilled in adolescence and (supposing the investigation can be still carried on) in adult life "

After all, intelligence tests are highly correlated with examination tests—even if we admit them to be an advance—but examination tests have not been very successful in bringing into the lime-light undoubted genius The London County Council has to deal with something like a permanent stock of half a million children, and annually some 30,000 may be selected for secondary education, from these again, later on, a further selection is made for academic training This has been in progress for thirty or more years, and a sample of 'gifted' children far larger than the Californian has been followed up and trained Individuals of various degrees of real ability have been recorded and have obtained substantial positions in a number of professions But will anyone venture to assert that a real genius has been netted by these tests? Yet if the tests have been cruder than the Californian —which we leave others to settle—they have dealt with incomparably greater numbers

The age differences form one of the major difficulties of the whole of the present investigation The same tests cannot be satisfactorily applied to children and to adolescents This is well illustrated when our authors come to deal with the changes during six years in the intelligence quotient of the 'gifted' children We find only 38 boys and 34 girls re-tested, and when these are divided into four age groups, we find four out of the total eight groups have only 5 to 6 children in them Statistically such numbers are wholly inadequate if we desire to reach safe conclusions Our authors themselves write

" The age range of the subjects was so great that no test, whether of intelligence, achievement, or personality, was suitable to all Moreover, because

of the limitations of time and funds it was not possible in the case of most of the tests to give them to all of the subjects to whom they were applicable However, in each case, the number tested is large enough to give a fairly reliable sampling To find out how a group of a thousand gifted subjects compares with a norm group, it is not necessary to test all of the thousand By testing a random sample of one hundred to two hundred of the thousand, we learn almost exactly as much as if we had tested all " (p 9)

When we remember that the children were originally selected as gifted on the basis of a single individual test series, the Stanford-Binet, the reasoning cited above seems somewhat obscure If a thousand children agree in excess of intelligence by a particular test, it by no means follows that a sample of a hundred—and it is occasionally smaller —will fairly represent the thousand in a great variety of other characteristics of a markedly different nature

In fact, the diversity of ages, the diversity of races, the diversity of tests, and the diversity of characters discussed render the results difficult to interpret, and make it hard for the reader to find his path through the many answers to the many questions propounded to children, teachers, and parents on a variety of ' blanks '

It is, perhaps, idle when a vast task has been undertaken and is in part accomplished to suggest that it could have been better and more economic ally carried out otherwise, but it seems to the present reviewer that if 1200 children of the *same* age with $I\ Q$'s of 140 and upwards and the same number of children of the same age with $I\ Q$'s below 100 had been selected in 1921 and *both* series followed up, we should have known more eight years later than we actually do, when the control series has not been followed up These numbers would have allowed for wastage, and a comparison of even 800 of both series by the *same* intelligence test would have been most profitable and far more reliable than a test repeated on only 72 of the gifted child series Twenty years after the second testing, very little more than an examination of " Who's Who in America " would have indicated whether any of the ' gifted ' or of the mediocre children, as judged by public estimation, had reached marked distinction, to say nothing of attaining a claim to genius

The authors of this massive series of volumes set out with the object of ascertaining whether a high intelligence quotient in childhood was an indication of a possible future adult genius, and they saw a double method of approaching the solution of the problem (i) by following up ' gifted ' children, that is, those with a high $I\ Q$, and (ii) by studying the childhood of several thousand individuals considered to be geniuses, and allotting them $I\ Q$'s

The method adopted in the latter investigation seems to us now, as it did when vol *2* appeared, to be little short of perilous The details of the childhood of the great are in some cases ample, in others sparse But on the basis of these haphazardly recorded details, three judges (Prof Terman, Miss M A Merrill, and Miss C Cox, the extractor of the biographical data) have, on the basis of their knowledge of the characteristic doings and sayings of children of high $I\ Q$'s, attempted the converse problem and assessed the youthful intelligence quotients of the bearers of the earth's great names, and assigned to each of them an $I\ Q$ which is on the average upwards of 140—that of their gifted Californian children

" The most significant conclusion of the author [namely, Dr Catherine Cox, the compiler of vol 2] is that the extraordinary genius who achieves the highest eminence is also the gifted individual whom intelligence tests may discover in childhood The converse of this proposition is yet to be proved " (p 23)

This is the result of what we term the perilous process of assigning $I\ Q$'s to the childhood of the great The actual position of the writers is well brought out in the following words

' It seems *quite evident* * that while any person with an $I\ Q$ as high as 140 [in childhood] may have the sheer intelligence requisite for exceptional achievement [in adult life], only a very small proportion are likely to possess the total complex of mental and personal traits that cause an individual to become eminent If it were not that personality traits and other non intellectual aspects of endowment wield an enormous power to enhance or inhibit the individual's use of his intelligence, we might expect in ten or fifteen years from our thousand California gifted children such a crop of geniuses as has never before graced the population of a single State " (p 24)

There is no attempt in the present work to measure quantitatively these " personality traits and other non intellectual aspects of endowment " which enhance or inhibit the use of intelligence It is, perhaps, reasonable to assume such to exist, but it is pure hypothesis to assert that the youthful intelligence quotient is a measure of adult intellectual power, and that genius would be apparent but for these unmeasured and undetermined

* Italics the reviewer's

'personality traits' and 'non-intellectual aspects of endowment' If the object of 'following up' is to ascertain these inhibitions, then the wording should have refrained from dogma, until these traits had been discovered and measured

While many readers will be most interested in the chapter entitled 'Re tests of Intelligence", and particularly in the Summary' on pp 61 62, a word of warning seems to be called for While in the eight years the 'scores' of a number of children have changed considerably, sometimes up and sometimes down, we have no control series, and therefore no evidence of how in the far more extensive group of non gifted children (as judged by their *I Q*'s) individuals may have risen If one boy among 27 'gifted' children can rise 50 points in seven or eight years, is it not possible, nay, more than probable, that among the many thousands of 'non gifted' children in California one or more may rise even double this amount, and if that State is to produce a genius at all in the next twenty years, may he not have been a child with an *I Q* far below 140 when the 'gifted' children were sorted out?

Notwithstanding our doubts as to whether the £12,000 which the three volumes of this investigation have cost have been spent to the best advantage, we readily admit the great interest which every social investigator must take in the present volume, especially in the later chapters As a study of how far the promise of childhood will be fulfilled in adolescence there is a great deal to be learnt from the work, only we hold that it would have been wise to have kept the frequent discussions on genius out of it To approach the problem of genius statistically we must deal with a far more numerous population, spread over a much wider field than those of a few thousand Californian children If, against probability a world genius, a da Vinci, a Goethe, or a Bach, appears among these Californian 'gifted' children, it will be more a startling chance than any contribution to an understanding of the origin of genius This point seems to be almost admitted by the authors themselves (p 469), but if this be so, why have they chosen "Genetic Studies of Genius' for the title of their researches? Why have they mixed up, in almost every chapter, the problem of the origin of genius with that of the future achievement of bright children?

Lastly, may we add a word of criticism which may help the writers in succeeding volumes of this encyclopædic work? The treatment is largely statistical, but their statistical technique is often defective We may illustrate this by one example, that on pp 28-30, where the writers endeavour to find from their *I Q* ratings in 1921-22 and 1927-28 (on the basis of 54 cases!) the correlation between *I Q*'s in *general* at a given interval of time They have not published their correlation table, so that we ourselves cannot attempt to deal with it But as they appear to have mixed boys and girls with marked sexually differentiated means, the correlation will, anyhow determined, be largely spurious

In the next place, the authors state that it was impossible to use the product moment method owing to the bizarre form of the correlation table arising from the truncating of the general population by the selection of 'gifted' children Accordingly, they suggest three other methods (i) The 'tetrachoric' method Now, this is based on a normal distribution of the data, and could not possibly be applied to a truncated quadrant without replacing, which the authors have not done (but might have done), the three quadrants truncated (ii) By a theory as to the regression The means of the gifted children *alone* cannot possibly give, as the writers suppose the correlation coefficient in the *unselected general* population (iii) The deduction of the correlation from the standard deviation of the differences of the two ratings This, if accurately applied, should give exactly the same result as the product moment method which they have discarded at the outset Clearly the authors are unfamiliar with the fundamental formulæ for measuring the influence of selection on correlation We do not believe that much could be learnt by even treating the 27 boys and 27 girls independently, but if it is worth while attempting this, then surely it were better not to apply three erroneously adopted processes to heterogeneous material

The title of this encyclopædic social inquiry suggests that the writers originally meant to deal with *hereditary* genius There is little about inheritance in these volumes But with the first conclusion of their summary we are in whole-hearted agreement, for it coincides with much observation of our own

> Gifted children come predominantly from family stocks of decidedly superior intellectual endowment and slightly superior physical endowment' (p 472)

Perhaps we may hope that a future volume may be devoted to the quantitative development of this special topic We trust, if it be so, that the need for a control series will not be overlooked

KARL PEARSON

Photoelectric Cells

Photocells and their Application By Dr V K Zworykin and Dr E D Wilson Pp xi + 209 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1930) 12*s* 6*d* net

UNTIL recently, there was a serious lack of really representative books dealing with the theory and practice of the photoelectric and selenium cells Happily, this no longer exists, thanks to Dr Campbell and Miss Ritchie—whose exhaustive book is already in its second edition—and to Mr G P Barnard, whose recent treatise on the selenium cell, though perhaps not so critical a survey of the subject as it might have been, will certainly be regarded as a standard reference work

It may be said at once that the book under review cannot be classed with these Probably the authors did not intend that it should be, their claim being that the aim of the book is to introduce the general public to the modern 'electric eye', and to teach the layman its normal characteristics and its special idiosyncrasies

In spite of the authors' belief that the book presents an understandable account "not too technical for the untrained man and not too shallow for the specialist ", we would hesitate to say that it has achieved its object There are, however, certain classes of workers to whom the book will prove of use those interested in the construction of photoelectric cells, and more especially sound film engineers and others concerned with the general problem of amplification of photo electric currents and with any of the almost endless applications

The first six chapters are devoted chiefly to the theory and construction of the gas filled and vacuum cells, though the treatment is not so ex haustive as in Dr Campbell and Miss Ritchie's book A good deal of Chapter ii , on general theory, seems rather unnecessary Does the reader really expect, or want, a chart of the entire spectrum of radiant energy, or a description of black body radiation extending over several pages, in a book of this kind ?

Chapter vii is an isolated one entitled "Photo conductive and Photovoltaic cells ", and serves to illustrate the main criticism of the book, that in some chapters the treatment is not sufficiently thorough for the specialist This chapter, for example, introduces us to the selenium cell (to which Mr Barnard devoted 331 pages), the thalofide cell, and one or two photovoltaic cells, all in nine pages There is scarcely any further reference to them throughout the book

Two chapters (viii and ix) discuss various photocell circuits and the problem of amplification There are short chapters on the use of cells in sound-film work, the electrical transmission of pictures, and in television In a chapter on miscellaneous applications, some fifteen illustrations (again very condensed) are given of operations which the cell can perform The last chapter discusses directions in which progress may be expected towards the discovery of the ideal cell Several appendices are given at the end of the book F C T

Our Bookshelf

A Manual of Practical Vertebrate Morphology By J T Saunders and S M Manton Pp viii + 220 (Oxford Clarendon Press , London Oxford University Press, 1931) 15*s* net

THIS text book of practical work in vertebrate morphology covers the course for the first part of the Natural Sciences Tripos at Cambridge Its contents are as follows First, directions are given for the examination and dissection of the following types The lamprey, the skate, the whiting, the auditory ossicles and swim bladder of the roach, the salamander, the central and sympathetic nervous system of the frog, the lizard, the grass snake, the pigeon, and the brain of the sheep The authors have not included an account of a general dissection of a mammal, " as many excellent accounts of the dissection of the rabbit are easily available "

The descriptions are good and the dissections are well planned The authors have wisely refrained from inserting into these chapters discussions of the functions or evolutionary significance of the parts displayed, leaving such matters to the theo retical text books that must be read in parallel with a practical course of this nature But they append, after the chapters dealing with the dissections, a brief and highly compressed theoretical account of the vertebrate nervous system In the reviewer's opinion, it would have been wiser to leave this also to the theoretical books, where it can be given more spacious treatment Finally, there are four chapters dealing with the skeleton, in which the type system is abandoned and the different regions are taken one by one and examined in a great variety of animals

The book is attractively illustrated and contains a number of useful and original features

G P W

Science and Religion a Symposium Pp vii + 175 (London Gerald Howe, Ltd , 1931) 4*s* 6*d* net

IF a series of popular broadcast talks on science and religion is to be commended at all, the publica tion of the talks in print is certainly to be com mended, because the peculiar danger of this form of instruction is that there should be left upon the

mind of the listener a hazy impression, which he cannot clear up except by subsequent reading and thinking We do not agree with people who write to the papers to the effect that these talks are unsettling to those who listen to them 'The conflict between religion and science', to use the title of a nineteenth century presentation of the theme, has long been with us, but these talks exemplify the fact that there was never less real 'conflict' than there is at the present time Religion, or rather theology, has more or less adapted itself to the view of the universe taken by modern science, and the tone of men of science is very different from what it inevitably was so long as theology adhered to demonstrably impossible positions

The contributors to these twelve talks include five distinguished men of science, one philosopher, and six theologians—or, at any rate, churchmen We think anyone would agree that these twelve chapters are more suitable for careful reading than for mere listening, and that, to the intelligent reader, they may convey a fairly clear idea of authoritative opinion on the problems discussed He will gather also that when it comes to ultimate questions, there is divergence of opinion, not only between scientific workers and theologians, but also between, let us say, physicists and biologists, and he may be reminded of the proverbial query as to what is to be done when the doctors differ

Aeronautical Meteorology By W R Gregg, with the collaboration of C G Andrus, R N Covert, H M Hightman, V E Jakl, D M Little, F W Reichelderfer, J A Riley and R H Weightman Second edition, revised and enlarged Pp xvi + 405 (New York The Ronald Press Co, 1930) 4 50 dollars

This revised edition supplies, in a convenient form, the kind of meteorological knowledge which is required by the airman The author has since 1917 been in charge of the Aeronautical Division of the United States Weather Bureau, and is an acknowledged expert in upper air research There are sections contributed by other experts on fog, 'ceiling', and visibility, ice formation on aircraft, weather forecasting, instruments and methods of observations, airship meterology, and the Weather Bureau Airway Service

There is a discussion of the relative advantages offered by prospective Atlantic air routes and an account given of the meteorological conditions attendant upon Lindbergh's trans Atlantic flight A natural feature of the book is a representation of the various meteorological dangers that beset airmen, like squalls, fog, and ice, and one gathers that thunderstorms, for several reasons, should be given a wide berth As cloud scenery closely concerns the airman, the book is adorned by some handsome photographs of clouds The book, in fact, notwithstanding the amount of technical information which it is its purpose to give, is anything but dull reading, and the author shows his artistic sense in some enthusiastic tributes to the magnificence of thunder clouds

The Place Names of Galloway their Origin and Meaning Considered By the Right Hon Sir Herbert Maxwell Pp xlvi + 278 (Glasgow Jackson, Wylie and Co, 1930) 21s net

The English Place Name Society has introduced to a wider public the intense interest and value of a scientific study of place-names, especially in areas of racial contact The locality with which Sir Herbert Maxwell deals is particularly instructive from this point of view The great majority of the place names were originally in the Erse or Gaelic dialect No doubt they were perfectly intelligible until the introduction of Old Northern or Middle English Although they then remained unchanged, the ideas which had suggested them were forgotten Hence many of them can now be interpreted only through analogy with districts where Gaelic, Manx, or Welsh are still living languages Some, however, must, in the nature of the case, remain unintelligible, perhaps for ever Among the Galloway place names are names of rivers which, it has been suggested, may belong to the language of the aboriginal long headed, dark-haired population, and have affinities with Basque —an interesting suggestion, which unfortunately remains nothing more at present The author has some interesting and pertinent observations to make on the difficulties in the way of adopting the latest views on the ethnological problem of Celtic settlement The place names of Galloway belong to the *q* Celts, while the neighbouring area of Dumfries is Brythonic

Forged, Anonymous and Suspect Documents By Capt Arthur J Quirke Pp xii + 282 (London George Routledge and Sons, Ltd, 1930) 15s net

The public taste for amateur detective literature was largely stimulated during the last quarter of the nineteenth century, and the one amusing factor was the unwarranted contempt poured upon the Criminal Investigation Department at Scotland Yard In this book, however, Capt Quirke (handwriting analyst to the Department of Justice, to the Attorney General, and police headquarters, Irish Free State), whilst possibly somewhat patronising in his prefatory attitude to the police force, writes not as an amateur but as an official expert, mainly for the benefit of the legal profession and the police From the individuality of handwriting he proceeds, by way of an extended consideration of analytical methods, to the details of materials and processes, arriving eventually at an illuminating exposition of the ultra violet rays and the fluorescence test The infallibility of this test in the detection of forgeries, as proclaimed by him, is supported by its practical adoption by the Bank of England The author emphasises his views that not only are no two handwritings indistinguishably alike under test, but that this also applies to any two typewriters, even those of the same make and same age The longest and perhaps the most abstruse chapter deals with a practical analysis of handwriting, a systematic study of which might prove to be beneficial to the public at large P L M

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Propagation of Magnetic Disturbances along Wires

IT is well known that the magnetisation of a ferro magnetic material changes in small steps (Barkhausen effect) We have shown [1] for a variety of materials that the sizes of these steps, or sudden changes in magnetisation, are independent of the sizes of the crystals of which the material is composed, and

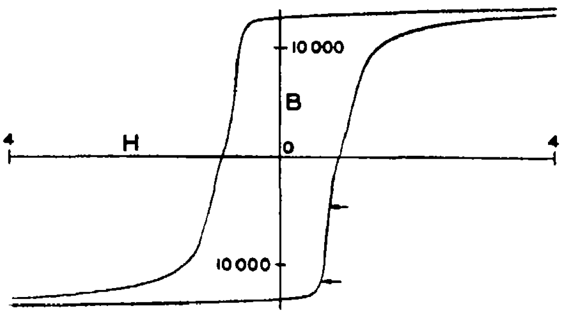

FIG 1 —Hysteresis loop of Armco iron maximum field strength 10 gauss

correspond to the sudden reversal of the magnetic moment of a volume of material of the order of 10^{-8} or 10^{-9} cm [3]

We now find that in many materials these small steps in magnetisation occur in groups of such size as to be detectable with a sensitive galvanometer This effect for iron is illustrated in the accompanying figures Fig 1 shows a hysteresis loop of Armco iron recorded photographically with the fluxmeter recently described by Haworth [2] No discontinuities are apparent here Fig 2 represents the portion of the loop lying between the arrows shown in Fig 1, recorded more slowly with greater fluxmeter sensitivity, and shows the large steps under consideration These steps appear only when the field is changed slowly, this is because it takes the magnetisation several tenths of a second to increase in any one step, and if during that time the field strength increased enough to set off the next change in magnetisation, the steps will not be separable While taking Fig 2 the field strength was changed 0 2 gauss per minute

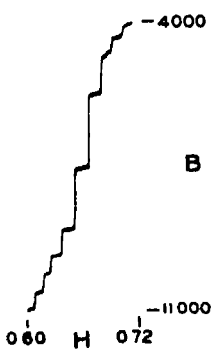

FIG 2 —Portion of loop of Fig 1, recorded slowly

That each such step in magnetisation is composed of a great many separate smaller changes is shown in Fig 3, where the whole record refers to the change in magnetisation occurring in one of the steps shown in Fig 2 Each sharp point of the record indicates one of the small steps or discontinuities discovered by Barkhausen The record was made with the usual arrangement [3] of search coil, amplifier, and oscillograph, used with a slowly and uniformly changing magnetic field strength

Separate tests have shown us that the change in magnetisation corresponding to one of the single steps of Fig 2 occurs throughout all sections of the sample, except near the ends, where the field is far from uniform This fact suggested that the magnetic disturbance was transmitted from one part of the sample to another by mechanical vibrations produced by the sudden change in length accompanying the change in magnetisation (magnetostriction) The other way in which the disturbance might be propagated is by magnetic influence alone According to the latter idea the increase in magnetisation occurring at one point increases the field strength and consequently the magnetisation at nearby points To distinguish between these two methods of propagation, an experiment was made as follows The large step like changes were made to occur over almost the whole length of the iron wire as before, but were prevented from occurring in a length of two centimetres in the middle by applying a field there in the opposite direction The sudden changes in the two halves of the wire were then found to be completely independent of each other, or incoherent, whereas with no back field in the middle they were always coherent Since elastic waves pass unhindered through the middle portion and experiment showed that no change in magnetisation occurred here, it is concluded that purely magnetic processes are responsible for keeping the disturbance going once it is started

We have examined similar disturbances in annealed iron wires so fine as 0 0017 cm in diameter and found that the changes in magnetisation are in much larger steps, a single step accounting for almost the whole change from saturation in one direction to saturation in the other These recall the results in hard drawn wires under tension and torsion described by Preisach [4] and by Sixtus and Tonks [5] In our own experiments, when the diameter is less than about 0 01 cm, the

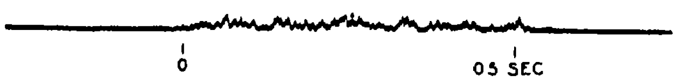

FIG 3 —Oscillograph record of one of the single steps of Fig 2 ordinates proportional to time rate of change of magnetisation

separate small Barkhausen discontinuities cannot be detected even with an oscillograph recording frequencies up to 4000 cycles per second The whole change occurs in one step and travels along the wire with a speed inversely proportional to the square of the diameter of the wire This also suggests that the magnetic field strength controls the propagation since the rate of decay of eddy currents varies inversely as the square of the diameter

R M BOZORTH
J F DILLINGER

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New York N Y ,
April 6

[1] *Phys Rev* (2) **35**, 733 52 , 1930
[2] *Bell Sys Tech Jour*, **10** 20-32 , 1931
[3] *Loc cit* 1 The oscillograph was recently described by A M Curtis *Bell Record* **8** 580 1930
[4] *Ann der Phys* (5), **3** 737 99 1929
[5] *Phys Rev* (2), **35**, 144 1 , 1930

The Earth's Thermal History

DR J H J POOLE has kindly pointed out to me that the reference to the adiabatic gradient of temperature in my previous letter [1] is capable of being understood to mean that he believes that the adiabatic gradient in a liquid heated below would not be maintained This was not intended , the maintenance of the adiabatic gradient by convection currents (or rather, of one exceeding it by the trifling amount

needed to start and maintain convection currents) is essential both to his views and mine. My point was simply that excess heat would be carried up by convection currents, as in the formation of cumulus clouds on a summer day, while a passage in his letter had appeared to cast doubt on this.

My own views on the earth's thermal history have undergone some change since my original criticism of Prof. Joly's theory, and Dr. Poole's theory also differs from the original (he does not appeal to Prof. Joly's bodily revolution of the crust to ensure resolidification). An important change on both sides has been in the recognition of the importance of the fact that the melting point gradient in rocks is steeper than the liquid adiabatic. This was first noticed by Dr. L. H. Adams and rediscovered by Drs. J. H. J. and H. H. Poole. My present views are given in "The Earth", second edition, pp. 138-148.

I have not yet had time to study Dr. Poole's paper[2] in detail, but it seems to me that its postulates differ from the geophysical problem in two respects. The earth is replaced by a deep vertical column, initially solid, with a non-conducting bottom. My view is that the earth was originally fluid throughout, and that it could never become solid throughout until such upward concentration of radioactive constituents had been achieved as to permit complete resolidification of the rocky shell. I think it improbable that the excess of the melting point gradient over the liquid adiabatic persists below a depth of a few hundred kilometres, so that the first solidification would be at an intermediate depth, and the condition at the lower boundary of the solid would be contact with a liquid in a convective state.

It seems to me that, apart from thermal considerations, there is a fatal defect in all theories requiring widespread weakness or fluidity in the lower layer of the earth's rocky shell (that is, between 30 km. and 3000 km. down) at any recent date. Evidence is accumulating to show that while isostasy is a first approximation to the truth, it is not exact. Heiskanen's ellipticity of the equator refers to the equipotential surface, not the solid surface. The corresponding difference between the mean and maximum radii of the equator of the solid, if the inequality is uncompensated, is about 0.7 km.; if compensated, it would have to be about 20 km., an entirely impossible amount.[3] The stresses involved in the support of this inequality must be distributed through a great depth, perhaps most of the thickness of the shell. There are several pieces of evidence tending in a similar direction, one of the most striking being the differences between the moon's moments of inertia, which must have persisted through most of the history of the earth. The recent work of the Indian Survey[4] and that of Dr. Vening Meinesz[5] constitute others. Now, if there had been any general fusion within a few hundred kilometres of the surface since these inequalities were formed, their pressure would certainly have displaced the liquid and restored the isostatic state.

I think we may go somewhat further than this. It is wildly unlikely that the material of the earth, at any depth, is a sufficiently pure substance to have a sharp melting point. For most geophysical purposes the melting point is the temperature at which the material acquires a sufficiently high viscosity to prevent convection currents; but the viscosity must vary continuously over a wide range of temperature. Now, in any theory of thermal cycles, after a solidification, heat transfer is by conduction and is a slow business. I think that in all such theories the variation of temperature in the solid between cycles is only a few degrees (except within, say, 50 km. of the surface). This applies to Prof. Joly's original theory, to Dr. Poole's modification, and to the various theories that Prof. Holmes has produced since he abandoned the theory of the earth's thermal history that he had done so much to establish, and which I still consider correct in essentials. To reconcile any theory of cycles with the observed imperfection of isostasy therefore requires that, in the lower layer, the strength of which supports the excess loads, a change of temperature of a few degrees corresponds to a change of mechanical properties, from sufficient softness to permit convection currents, to sufficient strength to support the stresses due to excess loads, normally of the order of 200 metres of material, and running up locally to some kilometres. It seems to me that the necessity of such a rapid change in strength with temperature in a substance without a sharp melting point is enough by itself to render any such theory untenable.

HAROLD JEFFREYS.

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[1] NATURE, April 18, p. 595.
[2] *Scientific Proceedings of the Royal Dublin Society*, vol. 19, No. 32.
[3] "The Earth", p. 222.
[4] NATURE, April 18, p. 593.
[5] *Geog. Jour.*, April 1931.

The Determination of Adsorption in Ternary Solutions

A NUMBER of attempts have been made to determine the adsorption of surface active substances from solutions containing salts, by the use of the Gibbs' equation, in the form

$$d\rho/d\mu_B = -\Gamma_B, \tag{1}$$

where $d\rho$ is the variation of the surface tension caused by a change $d\mu_B (= RTd \log a_B)$ in the potential of the substance B.[1] The complete equation of Gibbs as applied to a ternary system A, B, S is

$$\Gamma_A d\mu_A + \Gamma_B d\mu_B + \Gamma_S d\mu_S + d\rho = 0, \tag{2}$$

but if the dividing surface up to which the solution is supposed to be perfectly homogeneous is defined so that $\Gamma_A = 0$, this becomes

$$\Gamma_B d\mu_B + \Gamma_S d\mu_S + d\rho = 0. \tag{3}$$

This equation reduces to (1) when the variation of μ_S is negligible in comparison with that of μ_B. This will be the case when the concentration of B is very small, but will cease to hold at greater concentrations.

In dealing with a solution of A and B containing a salt S, it is more convenient in many cases to define the dividing surface so that $\Gamma_S = 0$, when (2) becomes

$$\Gamma_A d\mu_A + \Gamma_B d\mu_B + d\rho = 0. \tag{4}$$

This equation contains two unknown quantities Γ_A and Γ_B, which cannot be evaluated when the variation of $d\rho$ for known variations of $d\mu_A$ and $d\mu_B$ has been determined. But the composition of such a solution can be varied in two distinct ways: (1) by varying the proportions of A and B, keeping the amount of S constant; (2) by varying the concentration of S in solvents of fixed composition. For any given solution we may thus obtain two equations

$$\Gamma_A d\mu_A + \Gamma_B d\mu_B + d\rho = 0,$$
$$\Gamma_B d\mu_A' + \Gamma_B d\mu_B' + d\rho' = 0,$$

referring to variations of the two kinds mentioned, and these permit the evaluation of Γ_A and Γ_B.

In a binary solution of A and B, the surface *excess* Γ_B can only be identified with the actual amount of B present in the surface layer, when the concentration of B is small. In concentrated solutions, no method is available for determining unambiguously the composition of the surface layer.

It is evident that in the presence of a salt, which is

negatively adsorbed with respect to the other constituents, the method outlined may give a means of determining the actual composition of the surface layer

The measurements of the partial vapour pressures of water and alcohol in solutions containing various concentrations of lithium chloride which have recently been made in this laboratory by Shaw and Butler[3] provide the data required in these equations Mr A D Lees has determined the surface tensions of some of these solutions in order to test the feasibility of this method, and has obtained provisionally the following ratios for $\Gamma_{(alc)}/\Gamma_{(water)}$ in $1m$ lithium chloride solutions

Molar fraction of alcohol	6 4	25	80
$\Gamma_{(alc)}/\Gamma_{(water)}$	0 3	0 7	14

The vapour pressure measurements are being extended to solutions containing a lower proportion of alcohol, and it is hoped that eventually results will be obtained for a complete range of solutions

J A V BUTLER

The University, Edinburgh,
April 29

[1] For example, Goard and Rideal *J Chem Soc*, **127**, 1668, 1925
[2] Palitzsch *Zeit physikal Chem*, **147**, 51, 1930
[3] *Proc Roy Soc* A, **129** 519 1930

Disease in Nature

MOST naturalists would, I think, agree that wild animals have the appearance of exuberant health, and that it is quite unusual to meet with any obvious illness or disease But it is a very optimistic inference that civilised man might achieve the same state

So far as parasitic diseases are concerned, natural communities of animals, where there is no hygienic interference seem to come into a state of equilibrium with their parasites which is rarely broken through into either the complete destruction of the parasite or the appearance of an epidemic in the host Archdall Reid used to argue that human infections should be treated in the same way and left alone to do their worst

A great number, however probably the majority, of the bodily defects which give rise to the 'sub health' of human communities are due not to parasites but to age Man's body begins to decay at an age which varies widely in different individuals, but decay has generally definitely set in by the time a man is thirty his lungs are losing their elasticity, his aorta is getting fibrous, his respiratory and circulatory mechanisms are relatively inefficient few men can play first class football above thirty By forty five even his brain is growing smaller A large and increasing part of our population have, therefore, bodies which have deteriorated by the natural process of ageing, and there is no evidence that the enormous hygienic and medical advances of the last hundred years have done anything to postpone the effect of age The expectation of life at birth has nearly doubled, but for old men it is no greater than it used to be

In natural animal communities such age deteriorated individuals are eliminated by the ordinary processes of selection The same would presumably happen in man if survival depended on physical efficiency Artificial breeding experiments (for example, with mollusca) indicate that the possible length of life is much more than that usually attained in the wild state The wild populations are, therefore, healthy in a way which human populations can never hope to achieve It does not seem likely that hygienists can do anything very effective in altering the tissues on which injurious agents work, though they can, of course, do much in protecting man from such agents Whether the age at which the body begins to go downhill is a heritable quality I do not know it probably is, for length of life is intensely inherited The most likely eugenic procedure seems, therefore, to be to select for age at death

A E BOYCOTT

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Herts

THE discussions in NATURE of April 25 and May 9, on the occurrence of disease among animals and plants living under natural conditions, are of importance from several points of view, both economic and scientific While I do not admit the validity of the reviewer's distinction between internal predators and diseases, yet, for the sake of the argument, we can eliminate the huge death roll of insects due to insect parasites and still leave a large death roll due to diseases

Bacterial diseases are common among insects, especially during the larval stage, the larvæ of Lamellicorn beetles living in the soil being very subject to attacks of bacteria In the tropics many Lepidoptera larvæ suffer from such diseases Fungal diseases among insects are common all over the world, but more noticeably in tropical rain forests, where they are sometimes the chief controlling factor in limiting the numbers of some insects Economic entomologists are familiar with these facts

Insects attacked by these diseases show all the signs of 'disintegrative and deteriorative disturbances" shortly before death By saying that these insects are 'diseased' I may be "influenced by human prejudices', as Mr Maulik contends, but if we use the word in connexion with human beings, then it is also applicable to other animals No one would ever talk of Nature being 'diseased' or 'healthy', but we can apply those terms to animals and plants The word 'disease' is more convenient than the phrase "disturbed balance of metabolism"

Disease among insects leads to a speedy death, and the superficial observer only notes the active, healthy specimens In spite of the great importance of a correct knowledge of the death factors of animals and their relative values as selective factors, in our understanding of natural selection, only superficial attention, so far, has been given to this subject Among insects the greatest mortality falls upon the eggs and young, perhaps some eighty per cent, and the chief death factors are diseases (including parasitism) If we ignore this fact and base our statistics upon the idea that all, or the greater part, of the mortality falls upon the adult, and has selective value, we are likely to reach wrong conclusions For this reason, if for no other, it is necessary to recognise diseases (including parasitism) among insects, and their overwhelming value as death factors

F MUIR

Manoa, Warnham, Sussex,
May 11

Vegetable Juices as Fixatives

SINCE the article on "A Modified Gold Chloride Method for the Demonstration of Nerve Endings" was published by Mr Fred W Cairns, of Glasgow,[1] we have been experimenting with vegetable juices, other than lemon This communication is intended only as a preliminary announcement of the uniformly satisfactory and constant results that we have obtained with them, and we hope to be able to publish an account of our investigations in greater detail soon in the *Mysore University Journal* The following

juices have been employed, both for the purpose of demonstrating the nerve endings and for general histological investigations, with great success Onion

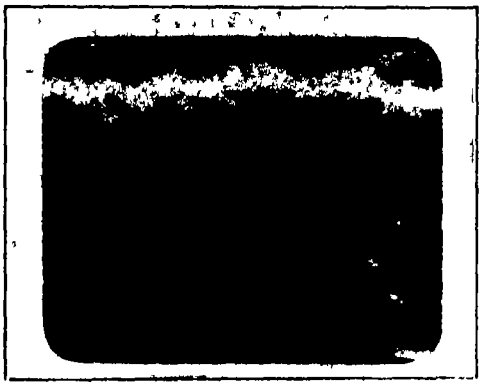

FIG 1 —Corpus luteum of domestic rat fixed in onion juice and stained with hæmatoxylin

FIG 2 —Nerve endings in the diaphragm of *Loris* onion formic gold chloride

FIG 3 —Nerve endings in the intercostal muscles of *Loris* citric formic gold chloride

juice (*Allium cepa*), mango juice, green and unripe (*Mangifera indica*), tamarind juice, green and unripe (*Tamarindus indica*), gooseberry juice (*Phyllanthus emblica*), sour milk (whey)

Three photomicrographs are here reproduced (Figs 1, 2, 3) to show the degree of accuracy and detail which may be obtained by these new methods

In addition to the above juices, we have also used uric acid from the urine of the pigeon, and also cow's urine, besides citric and formic acids We may only note here that vegetable juices with formic acid and 5 per cent formalin separately in certain proportions, which we shall announce soon, have also given very satisfactory results

A NARAYANA RAO
L S RAMASWAMI

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April 9

[1] *Q J M S*, vol 74 part 1, N S No 293 Sept 1930, p 151

Occurrence of *Protodrilus flavocapitatus* at Port Erin

BRITISH Archiannelids are so few in number, and their habitats so little known, that any new observations on their occurrence are well worth recording

One of the smaller members of the group, *Protodrilus*, was first taken in the adult condition on the south coast of England in 1913 [1] in a peculiar habitat, namely, just below H W neaps under stones embedded in fine gravel (pebbles 1 5 mm with larger constituents) and in the gravel itself in localities where fresh water runs into the sea It was later discovered in abundance in similar habitats—usually accompanied by the planarian *Procerodes ulvæ* (=*Gunda*), the isopod *Jaera marina*, and various Oligochæts and Gammarids—at numerous situations on the south and west coasts from Exmouth to Woolacombe, near Ilfracombe [2, 3] In June 1929 and April 1930 a careful but unsuccessful search [4] was made for this animal (by one of us, J H O, and Miss M K Molyneux) in the locality of Port Erin, in the Isle of Man

The search was continued this year and this interesting primitive worm found early in April in Port Erin Bay on Traie Vane and Spaldrick beaches, in habitats similar to those previously described [3] At other localities near Port Erin, namely, at Fleshwick Bay, Port St Mary (Mill Stream), and Perwick Bay, where streams run into the sea, *Procerodes*, *Jaera* and the other normal associates of *Protodrilus* were again found,[4] sometimes in great numbers, but the Archiannelid itself was not seen Comment on the apparent absence of *Protodrilus* from these localities is of little use at present, but a review of the habitats where the animal has been taken indicates that the following are important factors in determining the habitat (1) stones lying on fine gravel or coarse sand at about to a few feet below the level of H W neaps in (2) situations remaining at least damp at low tide, (3) the proximity of fresh water, and (4) protection from direct wave action In view of Pantin's recent work [5] on *Procerodes*, an additional factor is probably (5) the necessity for a certain concentration of calcium ions in the fresh water stream

The presence of shelving rocks below the H W neap zone undoubtedly affords the measure of protection from wave action conducive to a *Protodrilus* habitat, while in northern latitudes it is possible that beaches exposed to sunshine, as are those of Traie Vane and Spaldrick, are more suitable than others for a member of the genus *Protodrilus*, the centre of distribution of which is Lusitanian

The seepage water in which *Protodrilus* was living on the exposed beach at Traie Vane was found to vary in temperature closely with the air, except just after the recession of the tide A temperature so low as 7 5° C was recorded, but much lower readings would be obtainable in winter, the salinity showed only slight variations, as the fresh water stream was nearly

dry (about 29 to 33 per mille at pH 7 9 to 8 2 (corrected), as kindly determined by Mr J R Bruce), but lower salinities would occur after heavy rains On the south coast of England the animal has been taken in water which was almost fresh [1]

It is possible, therefore, that *Protodrilus* may occur in suitable habitats as far north as Scotland

The occurrence of 'red head', ventral eye spots, bifurcate caudal appendages, segmental cilia, and the characteristic numerous epidermal glands figured by Pierantoni [6] define the species as *Protodrilus flavocapitatus*, Uljanin, which, however, attains a larger size (lengths of 20 mm being common) than that recorded by Pierantoni

J H ORTON
H B MOORE

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April 16

[1,2] NATURE, 91, pp 85 and 348, 1913
[3] NATURE, 110, p 574, 1922
[4] 44th Ann Rep, Mar Biol Stat, Port Erin, 1931
[5] *Jour of Exper Biol*, 8, pp 82 94, 1931
[6] Fauna and Flora, Neapel, 31, Berlin, 1908

Wheat Surplus and its Cause

THE comment made by Prof Piaggio in NATURE of March 21, upon the address by Sir Arthur Eddington, cites the famous prophecy by Sir William Crookes, made near the end of the last century, as to the probable wheat supply in the future, say thirty years from the time of his address The comment indicates that the present wheat surplus is due to the recent advances in fixing nitrogen and making new fertilisers Sir William Crookes saw future controlled nitrogen fixation as the gleam of light amid the murky gloom of anticipated short wheat rations While modern fertilisers may have had a slight influence in bringing about the present flood of wheat, their effect has certainly been a minor one

The increase in the world's wheat production above what was anticipated is a complicated problem, but the utilisation of new types of machinery has certainly been a dominant factor Sir William Crookes instances eight States of the U S A located in a region "so arid as to be of infinitesimal value for food production relatively to the whole area" (with regard to tillable land) While he cites but 810,000 acres of this large area as devoted to wheat in 1897, we find that in 1929, thirty two years later, the wheat land of this region had increased to 7,500,000 acres, with a production of 100,600,000 bushels This nearly tenfold increase, in a region where further increase seemed impossible, has come about almost entirely because of the introduction of power machinery and the greatly increased utilisation of the combine harvester Other regions would tell a similar story Sir William Crookes's dictum was that the world's average yield per acre would have to be increased very materially to make up the impending shortage, and that such an increase would necessitate the comparatively abundant use of nitrogenous fertilisers This has not proved true

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Origin of *Spartina Townsendii*

FROM its characteristics and the circumstances of its origin, Stapf [1] and others have concluded that the cord or rice grass, *Spartina Townsendii* H and J Groves, must have originated on the foreshore of Southampton Water as a hybrid between *S alterniflora* and *S. stricta* The only objections to this have been raised on the ground that it is fertile and breeds true to type

Cytological study has shown *S Townsendii* to have 126 chromosomes in its root tip cells—nearly double the highest number previously reported in the Gramineae—and its putative parents have been found to have 70 and 56 respectively Those observations support the assumption that *S Townsendii* is of hybrid origin and, further they explain its fertility and its true-breeding behaviour It is an allopolyploid similar to *Primula kewensis* and other recent experimentally produced plant species

S alterniflora is generally considered to be an introduced species from America, while *S stricta* is native The hybridisation and chromosome doubling which have given rise to *S Townsendii* occurred in Nature, without human agency, but yet in such circumstances as almost to approximate experimental control *S Townsendii* has almost completely eliminated its parents wherever it has come into competition with them, and has spread very widely from its centre of origin It emphasises the fact that one of the results of allopolyploidy is the maintenance of hybrid vigour, and is a striking example of the significance of hybridisation followed by polyploidy in plant evolution, as it seems to rise above the objections which have caused some authors to hesitate in their admittance of full specific rank to newly originated allopolyploids

The economic significance of *S Townsendii* has been widely discussed and need not be considered here

A more complete account of the cytological observations is being published in *Genetica*

C LEONARD HUSKINS

Dept of Botany,
McGill University, Montreal,
Mar 26

[1] *Curtis's Bot Mag* 152, Tab 9125, 1926

The Altitude of Bird Migration

IN NATURE of April 18, T B Blathwayt records a party of egrets observed (through a telescope) migrating at night, and about five thousand feet up, and he asks if there are other records of a similar nature

In America some valuable material has been collected on the altitude of flight, by means of telescopic observations, but in Britain and elsewhere most of the scanty data have been obtained from aeroplanes Chapman [1] collected altitude records for 262 birds crossing the face of the moon, all between 1500 ft and 15,100 ft Scott [2] noted large numbers of birds migrating between five and ten thousand feet, and Carpenter [3] recorded birds passing over by night between 1400 ft and 5400 ft, while Winkendwerder [4] compiled a mass of information on migration by making telescopic observations

Meinertzhagen,[5] in a review of the whole subject, gives thirty six records of birds above 5000 feet (excluding the American work cited above) The greatest altitude for migratory flight known to me is that recorded at Dehra Dun, India, where a party of geese were accidentally included in a photograph of the sun, these birds were estimated to be flying at 29,000 feet [6] Lammergeiers, godwits, curlews, and choughs have been observed above 20,000 feet on Everest, and a number of birds (perhaps cranes) were noted from an aeroplane at 15,000 feet during the War [7]

There can be little doubt that the main bulk of migration (much of which passes by night) occurs at less

than 3000 feet But our knowledge is still far from complete, and all who may obtain observations on this subject should follow Mr Blathwayt's example by putting the occurrence on record (even if the species is not identified)

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[1] *Auk*, 1888, pp 37 39
[2] *Bull Nuthall Orn Club*, 6, pp 97 100
[3] *Auk*, 1906 pp 216 217
[4] *Bull Wisconsin N H Soc* 2, pp 97 107
[5] *Ibis* 1920 pp 920 936
[6] *Field* Dec 18, 1920, p 876
[7] *Ibis* 1919 p 321

Ultra-Violet Absorption and Raman Effect for Hydrazine

THE ultra violet absorption in hydrazine vapour, N_2H_4 (saturation pressure over the liquid at room temperature), consists of five or six nearly equidistant intensity maxima at about 2326, 2320 2276, 2250, 2225 A, followed by continuous absorption, beginning at about 2200 A and extending into the whole quartz region [1] The band absorptions are entirely devoid of rotation structures at 5 4 A per mm dispersion

To obtain some knowledge about the mechanism of dissociation shown at 2200 A, I have also photographed the Raman spectrum of the same substance using a column of liquid 1 cm in diameter and 10 cm in length, irradiated by a suitably filtered mercury arc so that only the radiations at 4047 A and 4359 A are effective (details of the experiment to be published in the *Scientific Papers* of this Institute)

Two sets of five sharp modified lines are observed under low dispersion, simply displaced by the separation of the two exciting lines, with the following frequency shifts from their respective lines of origin

$\Delta\nu$ (cm^{-1}) *a*, 900 (weak), 1120,
b, 3212, 3289, 3339

The *b* lines are nearly of the same intensity and agree very well with the triplet observed in liquid ammonia (NH_3) by Daure[2] and others They represent undoubtedly the *internal* vibration frequencies of the N H or NH_2 group, the last one corresponding to the absorption centre of the 3μ band of ammonia (3337 cm^{-1})

Now, Dadieu and Kohlrausch[3] interpret Daure's line of lower frequency, 1070 cm^{-1} of ammonia as due to the single bond vibration in the polymerised molecule $H_3N\ NH_3$ with quadrivalent nitrogen supposed to exist in liquid ammonia If this is true, my 1120 line is safely attributed to the N H (single bond) vibration in the hydrazine molecule

The hydrazine used was prepared from the hydrate $N_2H_4\ H_2O$, and the weak line at 900 cm^{-1} is probably due to hydrazine hydrate molecules still remaining This point I hope to verify with pure hydrate, but at the moment the substance is rather difficult to obtain

It is not difficult to imagine that the N N binding is very much loosened in an excited gaseous state, and the 500 cm^{-1} vibration frequency observed in ultra violet absorption may arise from this The dissociation of hydrazine vapour by 5 5 volt light absorption therefore seems to be effected by the breaking of the excited molecule in the middle Considering the sharpness of the spectrum, the bands preceding may be regarded as a structureless predissociation spectrum

S IMANISHI

Institute of Physical and
Chemical Research, Tokyo,
April 17

[1] *Sci Pap Inst Phys Chem Res*, 15, 166, 1931
[2] *C R Acad Sci* 188, 61, 1929
[3] *Naturwiss*, 18, 154 1930

Crystal Structure of Chromium Trioxide

SMALL thin red needles, heavily striated down the prism, were prepared by adding concentrated sulphuric acid to a cold concentrated solution of potassium dichromate The crystals were sealed up separately in thin glass tubes to prevent deliquescence Measurements on an ionisation spectrometer and from oscillation photographs gave the value of the cell size as $a = 8\ 50$ A, $b = 4\ 73$ A, $c = 5\ 72$ A, the probable error being not greater than $\pm$ 1 per cent The density given by Groth is 2 73–2 82 and there are therefore 4 molecules per cell The axial ratios given by Nordenskjöld[1] are $a\ b\ c - 1\ 0\ 69\ 0\ 63$ The relation between his ratios and ours is $a\ b\ c$ (Wooster) = $a\ \tfrac{3}{2}b\ c$ (Nordenskjöld) The only face from which he could obtain the ratio $a\ b$ should have been indexed (230) instead of (120) All the specimens which we have examined up to the present are mimetic twins on (110), closely simulating hexagonal symmetry

Ionisation and photographic investigations show the following halvings

(hkl) when ($h + k$) is odd
($0kl$) when l is odd

These suggest the space group Q_h^{17} - *Ccmm* and the co ordinates of the chromiums are as follows, the centre of symmetry being taken as origin $u, 0, \tfrac{1}{4}$, $\bar{u}, 0, \tfrac{3}{4}$, $\tfrac{1}{2}+u, \tfrac{1}{2}, \tfrac{1}{4}$, $\tfrac{1}{2}-u, \tfrac{1}{2}, \tfrac{3}{4}$ The value of u is doubtful, because the intensities are disturbed by the twinning, and fall off very rapidly, but u is probably about $\tfrac{1}{8}$ The observed halvings appear to require a structure consisting of tetrahedra of CrO_4 linked together in chains parallel to the c axis This would explain the cleavages, which are very well marked parallel to this direction and tend to cause the crystal to break up into fine needles

The work will shortly be continued at low temperatures and published in the *Zeitschrift fur Kristallographie*

W A WOOSTER
N WOOSTER

Mineralogical Laboratory,
Cambridge,
May 6

[1] A E Nordenskjöld *Pogg Ann Phy u Chem*, 114 622 1861

Deep Focus Earthquakes

IN a letter published in NATURE of Mar 28 (p 486), Mr F J Scrase, referring to an earthquake which was registered at Kew Observatory on Feb 20, explained briefly how it was possible to recognise the abnormal depth of focus and to make an estimate of this depth Confirmation of the deep focus of this earthquake has now appeared in a Seismological Bulletin issued by the Jesuit Seismological Association of America

From the fact that the primary pulse (or P wave reached Kew, Pasadena, and Riverview almost simultaneously, it is deduced that the epicentre of the earthquake was in latitude 44° N and longitude 135° E, about 200 miles from Vladivostok At every station for which the records have been examined, the interval between the times of arrival of the P and S waves was abnormally short for the distance from the epicentre Moreover, the arrival time at La Paz of P' (the horizontal wave which passes through the earth's central core) is about one minute early, and, as La Paz is at an epicentral distance of about 150°, this early arrival strongly supports the other evidence for deep focus

F J W WHIPPLE

Kew Observatory,
Richmond, Surrey,
April 30

Applied Geophysics

IN opening to the public a geophysical exhibition, and in publishing a handbook* which not only is descriptive of the exhibits but also constitutes an admirable historical résumé of and introduction to the study of applied geophysics, the Science Museum, South Kensington, has taken an important step in promoting the development of this branch of science, a step which is particularly appropriate at the present moment in view of the growing appreciation in Great Britain of the practical value of these relatively new methods of exploration The exhibition is specially arranged to demonstrate the nature of geophysical prospecting operations, the various forms of instruments and field equipment employed, and the types of practical problems with which they are capable of dealing Certainly, never before in Great Britain has there been a better opportunity for geologists and mining engineers to familiarise themselves with a subject which is rapidly becoming an important factor in the development of the world's mineral resources

In the handbook, the four principal geophysical methods (magnetic, gravimetric, seismic, and electrical) are dealt with individually In the first half of the book, an eminently readable and well-balanced historical account is given of these methods, with explanations in simple language of the general physical principles on which they are based Although the literature of applied geophysics is extensive and in many languages, it is not readily accessible to the public, but in these pages there is ample evidence of an extensive research into the development of the various methods and regarding the most recent practice both in Great Britain and abroad The sane outlook which is reflected will do much to dispel any misunderstandings which may have arisen in the minds of some in consequence of exaggerated claims or unduly sceptical opinions regarding geophysical methods of exploration that have occasionally appeared in print

It is appropriate that an authoritative work on this subject should begin by dispelling the popular misapprehension that there is some connexion between geophysical exploration and the divining rod an instrument which is aptly described on the second page as "an unscientific device depending on real or imaginary supernormal faculties possessed by certain individuals" This definition will be in accord with the opinions of most geophysicists and geologists The persistence of the popular belief in the divining rod is truly remarkable, and it may be of interest to mention that in certain of the more remote parts of the British Empire the faith in this device for locating water is so ingrained that professional diviners are still employed upon the staffs of some government departments

Although the full theory of the several geophysical methods requires a somewhat specialised study, the fundamental principles which underlie their applications to the search for mineral deposits and to the investigation of geological structures are relatively simple, and thus it will be readily appreciated that most minerals of economic importance possess some characteristic feature by which they may be distinguished from the barren rocks which enclose them For example, some iron ores have distinctive magnetic properties, whilst most metalliferous minerals have a relatively high density Amongst the latter there are many which are also good conductors of electricity, the sulphide ores of iron copper, and lead being notable examples In the non-metallic group of minerals there are not so many outstanding cases, but advantage may sometimes be taken of the low density of certain types of coal, and several important discoveries of oil are due to the fact that rock salt also has distinctive physical properties, namely, a low magnetic susceptibility, a relatively high density, and a high elasticity In the coastal oilfields of Texas and Louisiana, the oil is characteristically associated with large plug like masses of salt Although the oil cannot be detected directly, it has been possible to locate these *salt domes* by geophysical methods, and thus to discover the oil bearing ground Magnetic, gravimetric, and seismic methods have all been used for this purpose, the success obtained by the latter being most remarkable

The physical properties upon which the magnetic, gravimetric, seismic, and electrical methods are based are, therefore, those of magnetic susceptibility density, elasticity,† and electrical conductivity Whilst the magnetic and gravimetric methods are concerned entirely with naturally occurring phenomena (anomalies in the earth's normal magnetic and gravitational fields), it is apparent that the elastic and electrical properties of a concealed body are quite inert, except in response to an artificial applied stimulus In the case of the seismic method, waves are propagated in the ground by means of explosive charges which are usually buried a few feet below the surface The speeds with which these waves travel are measured with portable seismometers, and by plotting a series of time distance graphs for each explosion, the structural features of an area may often be determined with a high degree of accuracy In the electrical methods, current is applied to the ground, either conductively by means of earthed electrodes or inductively by insulated loops of wire which are connected to a source of alternating current A search is then made with suitable

* Board of Education Science Museum Applied Geophysics a Brief Survey of the Development of Apparatus and Methods employed in the Investigation of Subterranean Structural Conditions and the Location of Mineral deposits By Capt H Shaw, with the assistance of J McG Bruckshaw and S T Newing Pp 101+10 plates (London H M Stationery Office, 1931) 2s net

† The velocity of propagation of a seismic wave through the ground is determined by the elastic constants and densities of the various geological formations that constitute its path $V = \sqrt{\frac{\text{Elasticity}}{\text{Density}}}$ is the general expression of this relationship

instruments (potentiometers, search coils, etc.) for departures from a normal current distribution or, in the inductive methods, for anomalies in the associated magnetic field. In favourable circumstances, it is possible in this way to locate the positions of conductive deposits lying several hundred feet beneath the surface.

What has been said with regard to mineral deposits also applies in principle to certain rocks and geological structures, a detailed knowledge of which is sometimes required for special purposes, such as oilfield exploration and various types of engineering problems. Although the contrast in physical properties between contiguous geological formations may not be so marked as between mineral deposits and their enclosing rocks, this fact is often compensated by the difference in scale of the two classes of investigation. Structural problems of the type referred to are usually concerned with large scale geological features in which a relatively small but consistent difference in a physical property may afford a satisfactory basis for a geophysical survey. Thus, the axis of an anticline may sometimes be determined from the fact that the material which constitutes its core is commonly of a somewhat higher density than the formations forming its flanks. A fault displacement may also be revealed quite clearly by a comparatively small difference in the mean magnetic susceptibilities of the rocks lying on each side of it.

The second half of the handbook issued by the Science Museum is descriptive of the numerous exhibits which, until the end of June, will remain open for inspection there. Although the full benefit from these pages can scarcely be obtained without a visit to South Kensington, the descriptions of the instruments are so lucid and well illustrated that there is much to learn from them alone. The historical range covered by the exhibition is very wide; in the case of the seismic method even dating back to a seismoscope made in China in A.D. 132, and in the magnetic method to an instrument made by William Gilbert in the year 1600. Of equal interest, however, and perhaps of greater importance from the point of view of the geophysicist of to-day, is a series of modern instruments, several of which are of so recent a design that they have not previously been seen in public.

Particular attention may be directed to certain of these modern instruments with which considerable experience has been gained by the Imperial Geophysical Experimental Survey during the past two years. This Survey, it will be remembered, has been conducted in Australia under the joint auspices of the British Empire Marketing Board and the Commonwealth Government, with the special object of testing the four principal geophysical methods under a variety of field conditions. The work of the Survey has now been completed, and a full report, under the title "The Principles and Practice of Geophysical Prospecting", will be available shortly.

In the magnetic section the Schmidt vertical variometer occupies an important position, since it is probably the best known and most extensively used of the more recent types of magnetic field instrument. It is intended for quick and accurate determinations of the relatively small anomalies in the earth's magnetic field that exist in the neighbourhood of certain types of mineral deposit and rock formation, and although well designed to withstand vigorous field conditions, it is certainly more portable and simple to use than any ordinary survey instrument, such as a theodolite or level. Experience in Australia with two of these magnetometers has shown that they are capable of detecting minimum variations in the vertical component of the order of 10γ (that is, 10^{-4} gauss), and that a careful and conscientious person is capable, after half an hour's instruction, of carrying out a complete series of field observations.

In general, it is found that the position of a hidden magnetic body or the details of a concealed geological structure are revealed most effectively by determining the variations in the vertical component of the earth's magnetic field at a series of points in the area in question, and by plotting the results of the survey in the form of lines (magnetic contours) joining all points at which the values of the anomaly are the same. In Australia the form lines of the Jurassic bedrock over a portion of the Victorian brown coal field were studied in this way, and by a somewhat similar method it was possible to delineate a complex system of Tertiary basalt flows which lies beneath an alluvial sheet in one of the New South Wales goldfields. The magnetic method has so many applications, and the observations can be carried out so rapidly and cheaply, that it is surprising that its importance as an auxiliary to geological survey work has received so little attention until within the last few years.

Amongst the gravimetric instruments, the gravity gradiometer is one of the most interesting, since it is a comparatively new development specially designed to comply with the two principal needs of the working geophysicist, which are portability and speed of operation. Advantage has been taken of the fact that the *gradient of gravity* is the primary requirement in a gravimetric survey, and that in the majority of economic investigations the *curvature values* may be neglected without materially impairing the value of the results. By eliminating the effects of curvature, it has been possible to produce an instrument (the gradiometer) in which very substantial reductions in the overall dimensions and in the free period of the beam have been effected. Two of these small balances were used in Australia by the Imperial Geophysical Experimental Survey and it was found that the gradiometer principle has much to commend it. Although less sensitive than the normal type of torsion balance these instruments are adequate for many practical purposes, and the advantages gained from the ease with which they are transported to the site of work and moved from one station to another, and from their increased speed of operation, are so great as to render them preferable for most surveys where curvature values are not essential. If curvature effects and a higher degree of sensitivity are required, then recourse must

be had to the larger types of instrument that are represented in the Exhibition

In Australia the principal use of the gradiometers was in determining the dispositions and boundaries of a concealed portion of the Victorian brown coal deposits, and they proved quite effective for the purpose One of the instruments used by the Survey is included in the Exhibition and may be compared with the most recent model which has been made by the Cambridge Instrument Company

The display of electrical prospecting instruments certainly merits special attention, since this appears to be the first occasion on which geophysical equipment of this kind has been open to public inspection In this connexion it is interesting to recall the following statement which appeared in 1927 in a report on geophysical surveying by a sub-committee of the Committee of Civil Research "In particular, the electrical method has throughout been treated as a jealously guarded secret trade process In the result, little information is available to the general scientific world regarding the methods employed the apparatus required, the field operations, or the interpretations of results We believe that a full disclosure of the scientific facts would tend, more than anything else, to stimulate the natural development of this method of geophysical surveying, by placing it on a scientific footing, similar to that of the gravimetric method"

During the past few years, efforts have been made to remedy this position, and it is hoped that the forthcoming report of the Imperial Geophysical Experimental Survey will be found to assist in this direction to a substantial extent Electrical methods were used in many parts of Australia, and several of the instruments which were developed and used by the Survey are to be seen at the Science Museum, with examples of the latest patterns which have resulted from the field experience gained during these investigations Amongst these are the standard types of equipment used in the well-established equipotential line and spontaneous polarisation methods, and the Bieler-Watson double coil, with which inductive fields are investigated, and the ratiometer apparatus which was described in NATURE of Jan 3, 1931, p 37, are also to be seen A further exhibit is the 'Megger' earth tester, which is now being used extensively in connexion with earth resistivity surveys

It is noteworthy that although the foundations of these four principal geophysical methods lie predominantly to the credit of pure research workers in Great Britain, the development of their practical applications is largely due to foreign enterprise, mostly on the Continent and within the last ten years in particular Although we must admit a serious lag in this important phase of the work, considerable satisfaction is to be derived from the ample evidence afforded in the Science Museum of the fruitful activity now being displayed by British geophysicists and instrument manufacturers It is also gratifying to know that this Exhibition is not the only step being taken in responsible quarters to ensure that the science of applied geophysics shall continue to be developed in Great Britain along progressive lines

A BROUGHTON EDGE

Ultra-Penetrating Rays *

By Prof H GEIGER, Tübingen

ABOUT twenty years ago we first noted the presence of a γ-type radiation of high penetrability, probably of cosmic origin, passing through the atmosphere The first fundamental experiments carried out by Hess and improved on by Kolhörster, in which an air-tight electrometer registered the ionisation current at different altitudes, showed us that the current increased with the altitude, at not more than a few thousand metres the current was several times larger than at sea-level These results indicated the presence of an extremely penetrating radiation, which seemed to be markedly absorbed by the atmosphere above us Great difficulties were met with in studying the nature of this remarkable radiation, due principally to its extremely weak intensity, high penetrability, and lack of properties affected by external influences Our knowledge progressed slowly, and only after many years of experimentation were we able to say that the penetrability is about ten times greater than the hard γ-rays of radium, and that the ionisation in air at sea-level is slightly more than 1 ion per second per cubic centimetre We were able to add that in the explorable regions of the atmosphere the radiation was diffuse, and, further, there seemed to be no relation to the daily movement of the sun Even at the present time, we cannot say with certainty that the variations observed in the intensity of the radiation are wholly of atmospheric origin or partly an intrinsic property

The doubtful origin and nature of this radiation continued to occupy our attention The old experimental methods had been exhausted and new ones had to be evolved to insure a better understanding of the problem During the past few years, we have progressed in two directions, namely, along electrometric lines by the improvement of the registration and the application of high pressure chambers, and by the method of electron counting In the pressure chamber the degree of ionisation produced in the gas by the ultra-radiation is measured, while in the tube electron counter the high velocity electrons coupled with the ultra-radiation are registered singly

The results obtained with these methods, in so far as they promise to aid in solving the problem, are discussed below Three experimental categories are apparent absorption measurements and the determination from the absorption coefficient of the energy of the radiation quantum, further, the coincidence measurements from which range and other properties of such high energy electrons, which are associated, if not identical, with ultra-radiation,

* Opening paper of a discussion at the Royal Society on May 14

can be studied, the last, which on further development will probably give us the important data, embraces those effects taking place at the boundary of two adjacent media

The principal aspect of the first of the above divisions is the hardest component of the complex ultra radiation Detailed knowledge is necessary here in order to analyse the complex absorption curve With the aid of well known formulæ, a knowledge of the coefficient of absorption enables us to determine the highest energy quantum The extremely thick layers of material necessary to reduce the intensity of the hard component of radiation to a small fraction thereof are scarcely available, but we may well use the great depths of water in certain lakes Regener has extended the noteworthy absorption experiment of Millikan and others by lowering his apparatus successively to depths of 236 m in Lake Constance The essentials of the apparatus are a pressure chamber with quartz fibre electrometer attached, where the deflections are photographically recorded every half hour by the automatic illumination of the quartz fibre At the greatest depths, where the ionisation was smallest, the successive half hour records were close to one another and the registration could, therefore, be continued for days at a time, but at the surface of the lake, the ionisation was so large that the quartz fibre completed its run in about five hours

By another series of experiments, Regener replaced the ionisation chamber by an electron counting tube, the record in this case being made by a small adding machine The sums registered were recorded every hour photographically on a slowly rotating plate On the surface, such a counter registered about 8000 electrons an hour, but at the depth of 235 m only 13, the residual effect of 500 particles per hour is, of course, subtracted from the above Both methods gave the same absorption curve, and showed, especially for the hardest component, which practically alone is present at depths from 80 m to 235 m, an absorption coefficient of 0 020 per metre water In other words, a thickness of 35 m water is necessary to absorb half of this radiation, which on the Klein Nishina formula gives a wave length of $0\ 63 \times 10^{-13}$ cm

A completely different view of the nature of ultra radiation was the result of a second series of experiments, in which the coincidences of two neighbouring tube counters were observed In this fundamental work of Bothe and Kolhörster, which was later extended by Rossi, two counters were mounted, one about 5 cm above the other Simultaneous photographic registration showed that quite a number of impulses occurred in both counters at the same time It is difficult to explain this phenomenon other than by the presence of fast electrons which pass through both counters In general, one would expect the presence of fast electrons associated with such penetrating radiation, however, the penetrating power of these electrons was of a very high order, practically as high as that of the ultra-radiation itself This was observed by placing a block of gold 4 cm thick between both counters, in this block only about 25 per cent of the radiation was absorbed

Regarding these experiments alone, one cannot help thinking that ultra-radiation is not of a wave nature, but consists rather of high velocity electrons This, indeed, was the general conclusion arrived at by Bothe and Kolhörster

Be that as it may, it is necessary to intensify all experimental methods to determine further the nature and properties of such ultra electrons Heidecke, in Tübingen, took steps in this direction, he measured the scattering of these electrons occurring in their passage through matter With the aid of two counting tubes (A and C), 21 cm apart vertically, he observed the coincidences which indicated the passage of ultra electrons through the spherical angle defined by both tube counters If a third tube counter B were so placed that the horizontal axes of all three were parallel and all in the same vertical plane, one would expect the middle tube to count simultaneously with the coincidences of the outer tubes (triple coincidence) To a large extent this was observed On moving the lowest tube C horizontally parallel to its original position, the expected reduction in the number of triple coincidences was observed In certain positions of C, an increase rather than a reduction in the number of triple coincidences was observed when a 5 cm lead plate was placed between B and C This can be explained by the scattering of a number of electrons by the lead which were registered by the tube C in its new position, this effect can scarcely be accounted for without scattering

We can now discuss the third group of experiments, which deal with transition effects Hoffmann, Steinke, Myssowsky, and others have found that by the passage of ultra radiation from one medium into another, absorption peculiarities take place For example, on passing from a less dense medium, such as aluminium, to a more dense medium, such as lead, the radiation is more highly absorbed in the first stages of transition in the second medium One is led to believe that the passage of the ultra-radiation through the lighter element results in the emission of soft secondary radiation Steinke, with an extremely sensitive compensation method, in which a Hoffman electrometer served as null instrument, could show that on placing an aluminium plate in the path of the rays the intensity of ionisation was increased instead of diminished

In my laboratory, similar experiments were also carried out, but with tube counters In one of these studies, a 5 cm thickness of lead and an equal thickness of aluminium were so placed that the ultra-radiation passed first through the lead and then through the aluminium before entering the counter After first determining the number of electrons in a given interval of time, the measurements were repeated with the plates reversed By interchanging the plates the absorption should have been the same, and a possible secondary radiation would have been noticed if it did not accidentally occur with equal intensity in both metals The

experiments, in fact, showed that with aluminium facing the tube counter, 5 per cent more electrons were recorded than in the reverse case A portion at least of the secondary radiation thus consists of fast electrons By varying the plate thickness as well as material, the penetrating power of such secondary electrons could be determined In the three substances investigated the range was approximately inversely proportional to the density and amounted in aluminium to about 4 cm These electrons, when compared with the ultra electrons, are extremely weak, yet of greater energy than those inherent in radioactive processes

It is not easy to interpret the origin of these observed electrons To take them for Compton electrons is scarcely permissible, for then their low and limited energy content cannot be explained furthermore, the slow electrons actually observed would then need to travel nearly perpendicularly to the direction of the ultra radiation, which is contrary to experiment On the other hand, should the nature of the ultra-radiation be electronic, we are led to explain the secondary radiation as due to 'branching', that is, the collision of ultra-electrons with the electrons of the filter substance The argument against the second view is similar to that given previously In both cases, whether of wave nature or electronic, we should expect the presence of electrons the energy of which varies and reaches a maximum comparable to that of the ultra particles themselves

We might further conceive the secondary radiation to be of nuclear origin, but the principal difficulty therein is the experimental fact that the electrons emitted from paraffin, lead, and aluminium have approximately the same energy content, in addition, observations indicate that the electrons travel chiefly in the preliminary direction

Only by regarding the ultra radiation as made up of material particles such as protons with the energy of an ultra quantum, does it seem possible to interpret the secondary radiation experiments The secondary radiation corresponds to the δ rays liberated by α rays Following Rutherford, one can probably understand the energy of the accelerated electrons as corresponding to the observed range

Obituary

PROF J LORRAIN SMITH, F R S

JAMES LORRAIN SMITH was born on Aug 21, 1862, the son of the Rev Walter Smith, of Half morton, Dumfriesshire He died in Edinburgh on April 18 As an undergraduate in Edinburgh he achieved considerable distinction in philosophy, and this early training had its influence on all his subsequent work and behaviour After he took to medicine and had qualified in 1889, he spent some years working at Oxford, Cambridge, Strasbourg, and Copenhagen, mostly on physiological problems and in association with J S Haldane He then went to Belfast as lecturer and afterwards professor of pathology, in 1904 to Manchester, when the combined chair was split into pathology and bacteriology, and finally, in 1912, to Edinburgh as the first professor of pathology who had no duties as a clinical physician

Lorrain Smith was an all round pathologist and, with his own hands or through his assistants, he worked at a variety of problems He will be remembered chiefly for two investigations His early work with Haldane on hæmoglobin and its relation to carbon monoxide led to the first practicable method of determining in man the volume of the blood and the total quantity of circulating hæmoglobin In Belfast he applied this to the investigation of human anæmias, and found that in chlorosis, then common among young women, the anæmia was due to the dilution of the blood with an excess of plasma without any real deficiency in the hæmoglobin, in pernicious anæmia, on the other hand, he showed that there was a substantial shortage of hæmoglobin whether the blood volume was normal or increased This conception of the disease as a plethora was quite novel, indeed, the possibility of such a condition in man had come to be gravely doubted as the result of the failure of the attempts which had been made to establish it experimentally Why the water in the body should be distributed in such an abnormal way has never been explained, and under modern conditions the disease is practically unknown

In Manchester, Smith became interested in fats and lipoids, and, in conjunction with Mair, devised two histological methods which have been taken into general use—the Nile blue sulphate stain for neutral fats and fatty acids, and the improvement and adaptation of Weigert's bichromate hæmatoxylin process to tissue lipoids, in which he collaborated fruitfully with his chemical colleague, J F Thorpe He also did sound work on the supposed toxicity of expired air, oxygen poisoning, typhoid fever in Belfast, trench foot, and other topics

Outside his laboratory, Smith was for thirty years one of the best known and best liked figures in British pathology He took a prominent part in the foundation of the Pathological Society of Great Britain and Ireland in 1906 and of the Pathological and Bacteriological Laboratory Assistants' Association in 1912—two complementary organisations which have made a great difference to professional pathologists and their technical assistants During a period of development in which pathology passed from being an appendage of clinical medicine to an independent status, his influence was always for the good

Pathology occupies rather an awkward borderline between science and technology, some pathologists are at heart medical men, some are biologists Smith was essentially a philosopher and a biologist and he continually aimed at finding a working compromise between his outlook and the practical requirements of a sound medical education Many of us will gratefully recollect his kindly encouragement of young people and his constant friendly cheerfulness A E B

Dr T V Barker

The death of Dr T V Barker on April 15 after a short illness, at the early age of fifty years, is a serious loss to the study of crystallography in Great Britain Born in 1881, at Lytham in Lancashire, he went up from Kirkham Grammar School to Exeter College, Oxford While studying chemistry as an undergraduate, he came under the influence of Sir Henry Miers, then professor of mineralogy at Oxford, and acquired an enthusiastic love for crystals which inspired him throughout his life He also studied in Munich under Prof Groth His election to a senior demyship at Magdalen in 1905 enabled him to devote himself to research, first in Oxford and afterwards in Russia

Barker's earlier work was concerned with the regular growth, in parallel position, of crystals of numerous soluble salts upon minerals and upon one another, and with its bearing upon isomorphism and similarity of structure, and led to the recognition of the importance of molecular volume and of 'topic axes' in relation to such parallel growth Many of these results have since been confirmed by the evidence of X rays

Later on, Barker worked for a time in St Petersburg, as a pupil of Prof Fedorov, with whom he collaborated in the publication of his monumental work, "Das Kristallreich", a dictionary of the forms of all the crystals so far described, by means of which any substance included in it might be recognised from the measurement of its crystals ('crystallochemical analysis') The method was, however, complicated and required an amount of specialised knowledge which prevented its general use, and after his return to Oxford in 1909, Barker devoted his attention to devising a simpler method of classification His book, "Systematic Crystallography", published last year, described the principles on which he proposed that a new dictionary of the crystal kingdom should be constructed, and it is much to be regretted that he did not live to supervise the execution of his project In this connexion he also published, in 1922, a book on "Graphical and Tabular Methods in Crystallography", with the view of simplifying and shortening the operations of measuring and describing crystal forms

At Oxford, Barker was successively demonstrator in mineralogy and University lecturer, and afterwards reader, in chemical crystallography, while he held a research fellowship at Brasenose College His lectures and classes did much to encourage the study of crystals among undergraduates, and he also endeavoured, by vacation courses to schoolmasters, to awaken an interest in the subject in schools During the last few years he had been led to take up administrative work, and since 1929 the increasing work of the University Chest, of which he had become secretary, had claimed his whole time He will be greatly missed on many University boards, as well as by his many scientific friends and colleagues in Oxford and elsewhere H L B

We regret to announce the following deaths

Dr Thomas Ashby, who was director of the British School at Rome from 1906 until 1925, and an authority on the archæology of Rome, aged fifty seven years

Prof J E Edwards, principal and professor of mathematics and physics at Queen's College, London, author of well known text books on the calculus, on May 16, aged seventy seven years

Prof T R Glynn, emeritus professor of medicine in the University of Liverpool, on May 12, aged ninety years

Lieut Col H T Morshead, Director of the Burma Circle, Survey of India, who was a member of the expeditions to Mount Everest in 1921 and 1922, on May 17, aged forty eight years

Mr F P Sprent, assistant keeper of printed books in the British Museum and author of many works on cartography, on May 16, aged forty-six years

News and Views.

The Prime Minister's announcement in Parliament upon the future policy of airship development gave little cause for surprise, and must presumably be received in the spirit of half a loaf being better than none The Government was faced with three courses of action (1) To continue on a programme of new ships, carrying on the development as experience dictates, (2) to cease entirely, disposing of *R100*, turning the Cardington works to other uses, and terminating our responsibilities to the authorities who erected the various colonial mooring masts as best we can, (3) to recondition the existing airship, and find sufficient money to allow a limited experimentation to proceed along lines that the Simon inquiry and the Aeronautical Research Committee have suggested The Government has chosen the last course, stating that it hopes that the use of the ship will serve to supplement the model experiments already made, will keep together a small nucleus of trained men, and will add its quota to the relieving of the local unemployment problem It is estimated that sums of £120,000, £130,000, and £140,000 should be sufficient for this during the next three financial years It is hoped that the various Governments concerned will agree to maintain their own airship stations where in existence

So far as it goes, there can be no objection to this scheme, but it is obvious that neither in the Prime Minister's statement nor the subsequent debate is there any recognition of the fact that there is any necessity to ensure the continuation of scientific thought upon the broad problems of future development That a select company of airship builders and operators will be maintained was stressed several times, but the fact that without a new building programme there will be no design staff kept together appears to have been entirely overlooked It is an open secret that the designers of both of the ships have already been practically dispersed, owing to the lack

of continuity in the building programme, and this further three years' interval will certainly serve to set the seal upon this unfortunate state of affairs Further, a suggestion that a scientific airship man should sit upon the Air Council in order to preserve contact with the experimenters at Cardington, and so keep the broader outlook of policy alive, was received by the Under Secretary of State for Air with the remarkable statement that "It is rarely the case that a scientific expert is an efficient administrator" Mr Montagu's opinion is singularly at variance with that of the rest of the aeronautical world It is no mere polite phrase, but a literal fact, that admiration of the administration of aeronautical scientific research in Great Britain is world wide Mr Montagu should make use of a press cutting agency, or even maintain a closer personal touch with the scientific men in his own departments

A LECTURE upon a type of airship that does not need gasbags and fabric envelope was given by Mr Carl Fritsche, president of the Aircraft Corporation of Detroit, before the Royal Aeronautical Society on May 14 This company has already built, and operated for two years, a small 'metal clad' airship of 202,200 cubic feet capacity, which carried a useful load of 1300 lb, in addition to fuel, oil, ballast, etc, at 70 miles per hour top speed It is filled with helium and has a remarkably low diffusion loss of only 12 lb of lift for every twenty four hours This is principally due to the impermeability of the metal skin, the use of which is made possible by a special system of riveting the joints, which is really an ingenious adaptation of the principle of sewing with wire This not only makes a gas tight joint possible, but very considerably reduces the labour and time needed for erection Compared with *R100*, using helium, a metal clad ship could carry an estimated load of 10,000 lb more, with 600 h p less in engine power A part of the lecture was devoted to a detailed estimation of the costs of working an Atlantic service with these airships Given a passenger fare of £180 and a mail subvention of £2 8*s* per mile, it was suggested that an air line could be run at a profit of twenty per cent a year This was provisional upon the ships being built and operated by an international company, with sufficient freedom from political restrictions to allow them to utilise their carrying capacity to the best advantage

THE Annual Report of the Council of Management presented to the members of the British Science Guild at the general meeting on May 12 illustrates the unique place occupied by the Guild in the national life of Great Britain, and the valuable services it is rendering in promoting effective contact between science and the general life of the community The value of the "Catalogue of British Scientific and Technical Books" prepared by the Guild is best attested by the publication of a third edition in September 1930 Its educational work is represented by the Norman Lockyer Lecture on "Science and Modern Industry", delivered by Sir William Pope, and the Alexander Pedler lecture on "Science Discipline", delivered by Lieut Col Sir David Prain, both of which received wide notice in the press Changes of officers during the year are recorded in the resignations of Lieut-Col W A J O'Meara from the office of hon secretary, and of Sir John Young from the chairmanship of the finance committee, and the appointment of Major A G Church as organising secretary

A VALUABLE result of the non political and national structure of the Guild is its ability to make authoritative representations on matters of public interest in which scientific considerations are involved Two instances of such representations are referred to in the Report, the first being the Memorandum of Evidence submitted by the Guild in June 1930 to the Royal Commission on the Civil Service The memorandum, which is printed in full in the Report, stresses the importance of the technical factor in many modern problems, and urges the necessity of remodelling the organisation of departments of State on the type adopted in progressive industrial concerns The Guild considers that the time is ripe for a simplified structure of the technical services, and the memorandum enunciates the principles essential for efficient administration, and urges that the heads of the larger and more important professional, scientific, and technical departments should be given full administrative status The chief defect in the organisation and structure of the Civil Service lies in the dominant influence of officers of the administrative and clerical groups An appendix to the memorandum outlines the factors responsible for the present unsatisfactory position of the 'expert' group in the Civil Service In January 1931, the Council of the Guild adopted an exhaustive report on the scientific and professional staffs in the public services and industry, which has been widely circulated and to which statement the non political and representative character of the Guild lends great authority The report is dealt with in our leading article this week

IN his presidential address to members of the Guild at the annual meeting, the Right Hon Sir Samuel Hoare, M P, referred to the more ambitious programme upon which the Guild is anxious to embark In additon to the contemplated investigation of the potentialities of existing industries and the effect of the proper application of science upon them, which would indicate how far reactionary influences, either of Government, employers, or trade unions, are impeding development, Sir Samuel Hoare urged the importance of a scientific study of the disarmament question The main problem of disarmament, and by far the most difficult, is that of the new weapons of warfare and the method of their control The relation of science and the attitude of scientific workers to gas warfare and other new forms of warfare require investigation by men of science as well as by politicians and the general staffs Politicians in particular need a scientific opinion upon these subjects for the Geneva Conference in 1932 If during the next six months the Guild can produce a report upon such questions, it will be doing most useful work in educating public opinion and in investigating a critical aspect of the most prominent question in foreign politics in the immediate future

THE philosophical faculty of the University of Berlin has conferred upon Prof R W Wood, of the Johns Hopkins University, Baltimore, the degree of Doctor of Philosophy (*honoris causa*) This is the highest honour which the faculty has in its power to give, and is a recognition of Prof Wood's contributions to physical optics In announcing the award, Prof Jaeger, the dean of the faculty, singled out as of particular importance Prof Wood's researches on the resonance radiation of gases and vapours These have certainly called for the exercise of the utmost experimental skill, and although initially conceived and carried out at a time when our knowledge of the structure of atoms and molecules was practically nothing by current standards, have contributed in no small degree, and continue to contribute, to our present ideas on "the exact nature of the piece of machinery which we call the molecule", to use Prof Wood's own words With the study of resonance radiation, however, one is tempted to associate Prof Wood's allied work on magneto optics, and to quote as an example of his ingenuity the separation of the *D* lines of sodium for work with intense beams of monochromatic light by the difference in their rotations More recently, Prof Wood has been interested in the Raman effect, where he has devised methods for reducing the time of exposure needed for recording the feeble spectra of modified radiation, and has also developed rapid methods for measuring up the Raman spectra In addition to his many experimental contributions to physical optics, Prof Wood is the author of two books on the subject, and has ruled gratings for other laboratories His work, although, naturally, carried out on rather different lines, is in every sense worthy of being ranked with that of Rowland and of Michelson

IN his second Rhodes Memorial Lecture, delivered at Oxford on May 16, Prof A Einstein discussed the application of the field equations of the theory of relativity to the problem of cosmogony When the general theory of relativity was first formulated, the universe was assumed to be of a definite size, and in order to make the field equations compatible with this assumption an arbitrary term was introduced Subsequent investigation has shown that even with this arbitrary term, the size of the universe could only remain constant under special assumptions—in general it would vary with the time The work of Hubble on the radial motion of the extra galactic nebulæ has shown that these systems of stars, distributed approximately uniformly throughout space, are all moving at very high speeds, which increase linearly with the distance Prof Einstein now omits the above mentioned arbitrary term, and his original equations lead to a rate of expansion which is related by a simple formula to the mean density of matter in the space under consideration The rate of recession observed by Hubble appears to agree approximately with the rate calculated from the formula if one assumes the density to be of the order of magnitude which appears to exist in the universe as we know it The main difficulties are the small value of the world radius (one hundred million light years), the comparatively short period of some ten thousand million years during which the space structure can have been expanding, and the conditions in the early stages before expansion had taken place Prof Einstein's next and final lecture on the latest developments of the theory will be given on May 23 at 12 noon, when the University will confer on him the honorary degree of D Sc

NEWS from the British Arctic Air Route Expedition, published in dispatches in the *Times*, shows that the main features of its work have been accomplished, happily without the loss of life that was at one time feared Last August, a meteorological station was founded on the Greenland ice sheet in lat 67° 3′ N, long 41° 48′ W, at an elevation of 8000 feet, about one hundred and forty miles north west of the expedition's base on Sermelik Fjord near Angmagsalik The station was merely a double canvas tent, since transport difficulties precluded a more substantial building Two men occupied the station until Oct 2, when they were relieved by two others On Dec 3 another relief party reached them, and it was then proposed to abandon the station, owing to the severity of the blizzards and the difficulty in sledging up sufficient food from the base Mr A Courtauld, however, offered to remain alone, in order to continue the important observations throughout the winter He was left with ample provisions to last until May Efforts to relieve him in the early spring failed Wireless messages to this effect reached Europe and caused anxiety and eventually alarm, which, however, was not felt at the expedition's base The Swedish airman Capt Ahrenberg made a fine flight from Europe to the rescue, and, reaching the station on the ice cap, found it deserted Mr H G Watkins with a sledge party from the base had reached it on May 5, and found Mr Courtauld safe and well, with ample food supplies On May 13 they were back at Sermelik Fjord The observations at the high level station are the first complete winter records from the interior of Greenland and should prove of great value

THE German Expedition to Greenland has sent to the *Times* a dispatch which seems to leave no doubt that its leader, Dr A Wegener, has perished on the ice cap This expedition, with its base near the Kamarujak glacier on the west coast, also placed a station in the interior The German station was in lat 71° 8′ N, long 40° W, which is about the middle of Greenland, 275 miles north of the British station It was set up last summer and inhabited by three men, Drs Georgi, Sorge, and Loewe, who were found safe on relief reaching them on May 7 It was then learned that Dr Wegener with one Greenlander had left the station on Nov 1 in an attempt to return to the base, which, however, he never reached The journey entailed a march of about three hundred miles, and though there appear to have been depots on the route, the risks entailed in winter darkness and blizzards were very considerable The German expedition used motor sledges as well as dog teams in travelling over the ice sheet, and while the mechanical transport proved satisfactory, reliance was placed

mainly on the dogs This station will provide another set of most important meteorological observations

THE subject of the Friday evening discourse at the Royal Institution by Prof J C Philip, on May 15, was "Experimental Aspects of Hydrogen Ion Concentration" Prof Philip pointed out that the contrast between solutions of strong and weak acids of the same total acidity is very marked These differences are determined by the degree of ionisation mainly, and in the case of a weak acid like acetic acid a distinction must be drawn between 'total' and 'effective' acidity, the latter quantity being measured by the hydrogen ion concentration and expressed in terms of the pH value (Sørensen) Besides the standard electrometric methods of determining hydrogen ion concentration, now being developed in the direction of continuous record and automatic control, the colorimetric method is found valuable in many cases The fact that for different indicators the colour changes occur at quite different pH values, and that the colour change in any particular case is not absolutely sharp but takes place gradually over a limited pH range, underlies the practical use of the colorimetric method It is assumed that two solutions which exhibit a colour match (for the same amount of indicator) have the same pH value In reality this principle is subject to some qualification A significant point that emerges from the study of hydrogen ion concentration is the extent to which the pH value of a weak acid is altered by the addition of a neutral salt of the acid Solutions which contain a weak acid in presence of its neutral salt have, moreover, a remarkably steady pH value, which is altered to a relatively slight extent by the addition of acid or alkali Because of the resistance which they offer to change of acidity, mixtures of this kind are termed 'buffer' solutions They play an important part in the accurate determination of pH values and the 'buffer' effect is of prime significance in the regulation of the hydrogen ion concentration of the blood

ON May 14 a discourse was given by Mr Sydney Evershed before the Institution of Electrical Engineers to commemorate the centenary of the birth of David Hughes The fame of Hughes rests on two works of creative genius the invention of the synchronous type printing telegraph and the discovery of the microphone Hughes was the grandson of a bootmaker at Bala, in North Wales He was born in London, but his family emigrated to the United States in 1838 He picked up some knowledge of electricity and at the age of twenty four completed the development of his printing telegraph It rapidly came into use in the United States and France, but England was almost the last civilised country to adopt it The success of his invention brought Hughes a large fortune and in 1875 he returned to England and made London his home Having leisure for research, he engaged in experiments which led to the discovery of the microphone Graham Bell solved the problem of the transmission and reproduction of speech, but some kind of relay was needed for large telephone systems This was found in the action of sound waves on the contact of electrical conductors Having discovered the full scope of the phenomena, Hughes gave his knowledge freely to the world in a paper read to the Royal Society on May 8, 1878 In this paper, Hughes gave the name 'microphone' to any device in which sound waves acted on electrical contacts From that day to this, every instrument employed as the transmitter for a telephone system has embodied some form of Hughes's microphone to serve as a relay He was a fellow of the Royal Society and a president of the Institution of Electrical Engineers

STANDARDISATION in the domain of chemical industry has moved a step forward with the inaugural meeting on May 7 of the provisional council for the chemical division of the proposed Standards Association of Great Britain Negotiations, having in view an extension to other fields of the good work done by the British Engineering Standards Association, have been proceeding actively and harmoniously during the past year, with the result that agreement has been reached on a comprehensive scheme of organisation The general council of the new body will be constituted by the election of nine members from each of the divisions and by the nomination of a representative each of the Board of Trade, the Department of Scientific and Industrial Research, the Federation of British Industries the Association of British Chambers of Commerce and the Institution of Civil Engineers There will be four co equal and largely autonomous main divisions, each controlled by a divisional council, for engineering, chemistry, building, and textiles The engineering division will consist of the present B E S A, with the exception of those elements which will now find a more appropriate place under one of the other divisions The council of the chemical division will consist of not more than 40 members, not more than five places being reserved for the co option of individuals whose services are likely to be of special assistance to the council Agreement has been reached regarding the nominating bodies, each of which will nominate one member, with the exception of the Association of British Chemical Manufacturers, which will have five representatives Dr E F Armstrong has been elected chairman, and Mr W Rintoul vice chairman The council itself will not undertake the specification of standards, but will utilise existing organisations which are already engaged in that work Where necessary *ad hoc* technical committees representing the main interest affected will be constituted

ON May 11, the Manchester and Altrincham Railway was changed over to all electric operation, after eighty years of steam working Although only twenty-eight miles of track, including sidings, are involved, it is of interest, as it is the first railway in Great Britain electrified on the standard 1500 volts direct current system adopted by the Ministry of Transport Its power is obtained from the Stretford Electricity Board at 11,000 volts three phase The 11,000 volt cables are in duplicate and are carried on wooden stumps along the tracks The district served is densely populated and so an accelerated service and more stations were

required Transformers are used at the substations to step down the high pressure power to rotary converters which transform the alternating into direct current By means of a pantograph, each set of two series connected 750-volt direct current motors in the coaches is connected between the overhead wires and the return rails To make the load more uniform and furnish a reserve of power, a battery of accumulators is installed at each substation The machines and switchgear at the substations are kept free from dust and dirt by combined vacuum cleaning and blowing apparatus There is one steel tank mercury arc rectifier for 1500-volt working at one of the substations This type of rectifier will probably be widely used in the future It was designed and manufactured by a British firm It is a twelve-anode machine and so the ripple in the direct current voltage is very small In order to prevent possible interference with telephone circuits, a smoothing circuit is provided This consists of a reactance coil on the direct current side and four resonant shunt circuits connected across the direct current load Experience with rotary converters has proved that this device is very efficient

IT is announced by Science Service, Washington, D C, that Dr William Wallace Campbell, director of the Lick Observatory and formerly president of the University of California, has been elected president of the National Academy of Sciences, in succession to Dr T H Morgan, of the California Institute of Technology, Pasadena Dr Campbell established his place in American science principally through his work in spectroscopic astronomy, he has also done notable work in solar eclipse problems He was born in Ohio in 1862, and went to Mt Hamilton as astronomer at Lick Observatory in 1891 In 1901 he was made director of the Observatory, and in 1923 president of the University of California He retired from the latter post recently, in order to return to active astronomical work Dr David White, of the U S Geological Survey, formerly home secretary of National Academy, has been elected vice president, and Dr Fred E Wright, of the Carnegie Institution of Washington, formerly vice president, has become home secretary Dr Peter Debye, the distinguished physicist of the University of Leipzig, has been made a foreign associate of the Academy, and the following new members were elected Henry Bryant Bigelow, Museum of Comparative Zoology, Cambridge, Mass (oceanography), Edwin Broun Fred, University of Wisconsin, Madison, Wis (bacteriology), Edwin Crawford Kemble, Harvard University, Cambridge, Mass (physics), Adolph Knopf, Yale University, New Haven, Conn (geology), Robert Harry Lowie, University of California, Berkeley, Calif (anthropology), Joseph Haines Moore, Lick Observatory, Mt Hamilton, Calif (astronomy), Robert Lee Moore, Austin, Texas (mathematics), Hermann Joseph Muller, University of Texas, Austin, Texas (genetics), George Linius Streeter, Department of Embryology, Carnegie Institution, Baltimore, Md (embryology), Margaret Floy Washburn, Vassar College, Poughkeepsie, N Y (psychology)

THE second general assembly of the International Union for the Scientific Investigation of Population Problems (chairman, Prof Raymond Pearl) will be held in London on June 15–18, at the house of the Royal Society of Arts, John Street, Adelphi, Strand, W C 2 Most of the European Powers and also the United States of America will be represented at the meeting The first three morning sessions will be devoted to official business, and the afternoon sessions and the whole of June 18 to reports and papers relating to the work of the Union Commission 1 (population and food supply) reports on the first afternoon, Commission 2 (differential fertility) on the second afternoon, and Commission 3 (vital statistics of primitive races) on the third afternoon The papers also to be read on these afternoons and those for Thursday, June 18, include studies on differential fertility in Stockholm, the birth-rate and population of the United States, and vital aspects of a Chinese family population during six hundred years, more general papers on population theory and human biology, and experimental work on mice populations Scientific workers are invited to attend the afternoon sessions and those on June 18 The organising committee for the meeting is the British Population Society, of which the chairman is Sir Bernard Mallet, and honorary secretary, Mr Eldon Moore, Eliot Vale House, Blackheath, Kent, from whom tickets can be obtained

A FEW months ago (Jan 31, p 176) we announced in these columns that arrangements were being made by the Society for Cultural Relations for a tour of British scientific workers to the U S S R Owing to the large demand for membership of the first party, the list for which closed on April 30, a second party will now leave London Bridge by Soviet ship for Leningrad on Aug 8, returning to London about Sept 2 in time for the British Association meeting The return fare will be £18 0*s* 0*d* The party will spend a total of sixteen days in Russia, and the cost per day will be £1 0*s* 0*d* per head inclusive Meetings are to be arranged which members of the party will be invited to address, and there will be excursions with guides to scientific institutions of interest to the members The party will consist of twenty five persons If there is a large demand for places, the list might be extended The latest date for receiving applications is June 15 Applications and all inquiries should be addressed to the Secretary, Society for Cultural Relations, 1 Montague St, London, W C 1

A CONFERENCE of agricultural and rural bodies met at the Ministry of Agriculture on May 13 to consider the damage caused by grey squirrels in Great Britain Mr A D Middleton, of the University Museums, Oxford, a summary of whose recent paper on the distribution and habits of the grey squirrel appeared in NATURE of April 4, p 540, reported the results of his investigations, and Mr L W Swainson, honorary secretary of the Anti-Grey Squirrel Campaign, described the activities of that body The conference passed a resolution expressing the opinion that the grey squirrel is a pest which causes extensive damage

to agriculture and horticulture, that it is widespread and increasing in numbers, and that it is in the interests of agriculture and horticulture that all possible steps should be taken to bring to the public notice the damage caused by these animals and the importance of repressing them. The Ministry of Agriculture was asked to issue an educational pamphlet on the grey squirrel, describing its life history and giving methods for its destruction, to be distributed to rural organisations with the view of encouraging the destruction of the pest.

THE Court of Common Council of the City of London has made a donation of two hundred and fifty guineas to the funds of the British Empire Cancer Campaign.

THE Honorary Gold Medal of the Royal College of Surgeons has been conferred on Mr. G. Buckston Browne, in recognition of his valuable contributions to the surgery of the genito-urinary system, and of his great liberality in the endowment of an institution for surgical research.

ON Feb. 10, Dr. Joaquim de Sampaio Ferraz resigned, for reasons of health, from his post as director of the Brazilian Meteorological Institute, which he initiated in 1921. Although he has retired from his official position, he intends to carry on his work in collaboration with M. Paul Pires Xavier, who has been appointed to succeed him.

THE portrait of Dr. G. Claridge Druce which was subscribed for by members of the Botanical Society and Exchange Club of the British Isles on the occasion of his eightieth birthday on May 23, 1930, has been painted at his residence, Yardley Lodge, Oxford, by Mr. P. A. de Laszlo. It will be formally presented to Dr. Druce at Mr. de Laszlo's residence in Fitzjohn's Avenue, London, next month.

AT the anniversary meeting of the Royal Society of South Africa, held on Mar. 18, a resolution was moved by Prof. Morrison and seconded by Prof. Newbery asking the Council to protest against the drastic reduction in the government grant to the Society for 1931. The following were elected as officers of the Society for the year 1931: *President*, Dr. W. A. Jolly; *Honorary Treasurer*, Dr. L. Crawford; *Honorary General Secretary*, Dr. B. F. J. Schonland.

PROF. I. E. TAMM, of the Physics Research Institute and professor of physics in the First University of Moscow, will speak on "Higher Education in Soviet Russia", at a meeting of the Society for Cultural Relations between the People of the British Commonwealth and the U.S.S.R., to be held on May 28. Further information concerning the meeting can be obtained from the Secretary, S.C.R., 1 Montague Street, London, W.C.1.

THE council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1930–31, or accepted for publication: the Institution premium to Commendatore G. Bianchi, Ayrton premium to R. Grierson, John Hopkinson premium to J. W. Rissik and H. Rissik, Kelvin premium to B. L. Goodlet, F. S. Edwards and F. R. Perry, Paris premium to P. J. Ryle, and extra premiums to W. E. M. Ayres, R. M. Charley, H. S. Carnegie, D. B. Hoseason, Dr. J. J. Rudra and Prof. Miles Walker, Prof. W. Cramp and A. P. Jarvis, P. J. Higgs, J. C. Prescott and E. W. Connon, G. G. Small, R. J. Brooksbank, and Prof. W. M. Thornton, Prof. S. P. Smith, and Prof. E. Wilson. In the Wireless Section, the Duddell premium has been awarded to T. Walmsley and extra premiums to C. E. Horton and C. E. Rickard. In the Meter and Instrument Section the Silvanus Thompson premium has been awarded to Prof. W. M. Thornton, M. Waters, and W. G. Thompson, and an extra premium to E. W. Hill and G. F. Shotter.

THE Secretary of State for Scotland has appointed Dr. Birkett Wylam to be Chief Inspector for Scotland under the Alkali, etc., Works Regulation Act and Inspector under the Rivers Pollution Prevention Acts, in succession to Mr. J. W. Young, who is retiring. Dr. Wylam, who enters on his duties on June 1, is a graduate of the University of Durham. On graduation as B.Sc. he obtained the Freire Marreco medal for practical organic chemistry and was engaged on post-graduate research work for two years. Since 1928 he has been working as research chemist, and latterly also as process manager, in works connected with Scottish Dyes, Ltd.

WE learn from the recent issue of the *Taylor Hobson Outlook* that the alteration in size or scale of the projected cinematograph image, seeing that the relative positions of the film, the projecting lens, and the screen are fixed, is effected by a change in the lens. To enlarge the image, the focal length of the lens must be reduced, and this is effected by making the front and back components movable axially and causing them to approach each other. To maintain the sharpness of the image, that is, to keep the film and the screen in focus during the change, the relative rates of movement have to be adjusted with great accuracy.

WE are glad to see that the Royal Photographic Society is giving rather more attention in its *Journal* to the scientific and technical side of photography than it has for the last few years. The April number of its journal has a 56-page supplement which consists of articles on the physical aspects of the latent image, the applications of physical chemistry to photography, recent progress in optics, photo-engraving, cinematography, colour photography, and commercial photography. This number also includes the eighth Hurter and Driffield memorial lecture by Sir William Bragg, on "X-rays and the New Range of Vision". In December, a special cinematograph number will be published, and other special numbers will be issued from time to time. The journal is published by the Fountain Press, 14 Clifford's Inn, at 2*s*. 6*d*. per copy.

THE latest issue of the Classified List of Publications of the Carnegie Institution of Washington (April 1931, 208 pages) contains a chronological list arranged under authors' names, a classified list, with summaries of the contents of papers, grouped under the appropriate branch of science, and an index of authors. Copies of the publications, sent gratuitously to a carefully

selected list of libraries throughout the world, may be consulted there, but books not otherwise disposed of are for sale at prices approximating to the cost of publication Correspondents may obtain price lists, or classified lists, as issued, by furnishing requisite addresses to the Secretary, Carnegie Institution of Washington It is unnecessary to stress the value of the publications in the various branches of science and letters issued by the Institution

Two books are nearly ready for publication by Messrs George Allen and Unwin, Ltd , which should be of general scientific interest namely, "The Universe in the Light of Modern Physics", by Prof Max Planck, translated by W H Johnston and "Human Heredity" by Profs E Bawe, E Fischer and F Lenz translated by Eden and Cedar Paul

Messrs Dulau and Co , Ltd , 32 Old Bond Street, W 1 have just issued Catalogue No 185—' Fungi, Plant Pathology, etc "—comprising a thousand works from the library of the late Dr N Patouillard Among the volumes offered for sale are Saccardo's "Sylloge Fungorum" Saccardo's Fungi Italici", Boudier's "Icones Mycologicae", Fries' "Icones Selectae Hymenomycetum ', Paulet's "Iconographie des Champignons" and Lucand's 'Suites a Bulliard Messrs Dulau have also circulated a list (No 186) of upwards of 600 volumes, mainly on natural history, now on sale at very low prices

Applications are invited for the following appointments, on or before the dates mentioned - Two full time tutors in the department of adult education of the University College of Hull—The Registrar, University College, Hull (May 26) An assistant lecturer in mathematics at Westfield College—The Principal, Westfield College, N W 3 (May 27) A teacher of science and engineering at the Coleraine Technical School—The Principal, Technical School, Coleraine (May 28) A vice principal of the Somerset Farm Institute, Cannington, near Bridgwater—The Clerk of the Somerset County Council, Ashcombe House, Weston super Mare (May 30) A chief cataloguer in the Library of the University of Aberdeen—The Secretary, University, Aberdeen (June 4) A resident assistant pathologist at the Royal Free Hospital and London (R F H) School of Medicine for Women— The Secretary, Royal Free Hospital, W C 1, or the Warden and Secretary, London (R F H) School of Medicine for Women, W C 1 (June 5) A secretary of the University Chest of the University of Oxford—The Acting Secretary, University Chest Office, Oxford (June 6) An assistant lecturer in philosophy at the University College of Swansea The Registrar, University College, Singleton Park, Swansea (June 6) A professor of mathematics at Raffles College, Singapore—The Director of Recruitment, Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 A physics mistress at Westonbirt School, Tetbury— The Headmistress, Westonbirt School, Tetbury, Glos A head of the mathematics department of the Borough Polytechnic—The Principal, Borough Polytechnic, Borough Road, S E 1 A laboratory assistant at the County Mental Hospital, Lancaster—The Medical Superintendent County Mental Hospital Lancaster

Our Astronomical Column

The Date of the Crucifixion – *Astr Nach* 5784 contains a paper on this subject by E Dittrich He makes use of data from the writings of the late C Schoch, both published and unpublished These include a discussion of the total eclipse of the sun of Nov 24 in A D 29 Some ancient writers attempted to explain the darkness mentioned at the Crucifixion by this eclipse The explanation is, of course, impossible, for the double reason that the Passover comes near the spring equinox and also near the full moon Still the statement has some value, for it would scarcely have been made unless the year of the eclipse agreed with that of the Crucifixion or came very near it The track of totality was investigated by Schoch, who found that it ran just north of Palestine, the maximum phase at Jerusalem was 11½ digits and occurred 12 minutes before local noon An argument is based on the incident of the corn being ripe enough to eat the ears at a time a little before the Crucifixion The Passover must have been rather late the preceding year having an intercalary month at the end of it In summing up, the author observes that the discussions of the last hundred years have greatly narrowed the possible range of dates The range was originally about ten years, but has now been reduced to two , there is almost universal agreement that it was either A D 29 or 30

Temperatures in Sunspots —In the *Scientific American* for April, Prof H N Russell gives an account of recent work on sunspot temperatures carried out at Mt Wilson by Pettit and Nicholson with the aid of a delicate vacuum thermocouple In violet radiations, the spot gave less than 30 per cent of the disc, but in the red the proportion was 40 per cent and in the extreme infra red it reached 80 per cent A mean was taken as 47 per cent, which was reduced to 40 per cent when the scattering of sunlight by the atmosphere was allowed for This gave 4750° C measured from the absolute zero about 1200° cooler than the general surface temperature The cooling is ascribed to the rapid expansion which the gas undergoes on ascending from a lower region of higher pressure This implies that the portions of sunspots that are accessible to study are quite shallow , but an explanation, due to Unsold, is given, suggesting that the mechanism producing the spot is much deeper, about 1000 miles down , the hydrogen atoms are there ionised, but as the column ascends, recombination of protons and electrons liberates enough heat to maintain the vertical current, which, as stated above, is cooled by expansion on reaching the surface

Catalogue of Stellar Parallaxes —*Publication* No 4 of Merate Observatory is a general catalogue of 3975 stellar parallaxes compiled by Gino Cecchini It includes trigonometrical parallaxes determined at all the leading observatories, also dynamical, hypothetical, group, and Cepheid parallaxes, distinguished by different symbols The catalogue gives approximate R A and Decl for 1900, magnitude, spectral type, parallax, probable error (each given to 0 001″), absolute magnitude, proper motion in polar co ordinates, and references to Boss, Cincinnati, and Draper Catalogues Proxima Centauri is entered as type *M*, parallax 0 780″ ± 0 006″, absolute magnitude 15, proper motion 3 76″ in P A 283° Notes and references follow the catalogue, the whole making a useful work of reference

Research Items

Peking Man: Geological and Palæontological Evidence.—An account of the discovery of Peking man is contributed by P. Teilhard du Chardin to *L'Anthropologie*, t. 41, pts. 1-2, which deals in some detail with the geology and palæontology of the cave of Chou Kou Tien. It is evident that the cave was not an open fissure in which the remains were carried by torrential action, as was at one time thought, but a true cave which was gradually filled by a succession of deposits. The nature of these deposits points unquestionably to the fact that the cave was the habitation of carnivores, and presumably of man. It presents analogies with the caves of Europe, but the evidence of stratigraphy and palæontology points to the far greater antiquity of the levels in which human remains have been found. Hitherto only one pleistocene formation had been recognised in China, that of the yellow loess characterised by *Rhinoceros tichorhinus*, *Bos primigenius*, *Cervus elaphus*, *Hyæna crocuta*, etc., and worked quartzites of Mousterian and Aurignacian type. Now, however, it is evident that beneath the loess deposit of the Upper and Middle Pleistocene, and hitherto confused with it, is a series of sands, clays, and reddish loess representing a distinct formation with a characteristic fauna, *Rhinoceros cf. sinensis*, *Hyæna sinensis*, *H. machairodus*, etc. This formation begins at the end of the tertiary and the beginning of the lower quaternary. It is to this Early Pleistocene that the fossiliferous deposits of Chou Kou Tien belong. On this point the palæontological evidence is decisive. No fossil characteristic of the yellow loess has been found at Chou Kou Tien, the fauna of which corresponds with the pleistocene fauna of the Nihowan deposits, yet is lacking in those forms which assign the latter to the tertiary. In the rhinoceros, hyæna, horse, *Canis sinensis*, *Machairodus*, there is exact correspondence.

A New Classification of Mammals.—In the course of arranging a large collection of mammal skins for cataloguing, storage, exhibition, and teaching, George Gaylord Simpson found it necessary to compile a workable synthesis of recent taxonomic studies of mammals. This classification of the living and extinct forms is now published for the use of workers faced with the same problems (*Bull. Amer. Mus. Nat. Hist.*, vol. 59, p. 259; 1931). The classification is conservative; it follows a middle course between the 'splitters' and the 'lumpers', but, as it is, it summarises the progress of the last half century. Where Gill's work of 1872 contained 138 families, of which 33 were extinct and 105 living, the present classification contains 242 families, 129 extinct and 113 living. It is clear that the progress of the intervening years as regards numbers of families has been due almost entirely to palæontological discovery, and that although many new species of living mammals have been described, their discovery has added little to the broader taxonomy of the class. So also with the changes in arrangement and classification: comparative anatomy of recent mammals has made its proper contributions, but the discovery of their extinct ancestors has added much more. The discrepancy between the two sets of contributions is likely to increase, for while outstanding new discoveries are extremely rare in the modern groups, the rate of palæontological discovery tends to increase rather than diminish.

Nutrition of Mosquitoes.—In the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, vol. 24, pp. 465-472 (January 1931), Malcolm E. Macgregor describes some experiments dealing with the food requirements of mosquitoes with respect to ovulation. Two species were chiefly used in these experiments, namely, *Ædes ægypti* and *Culex pipiens*. The author points out that mosquitoes betray two methods of feeding. In the method usually known as 'biting' (or its equivalent, which can be attained by feeding from capillary tubes when the proboscis is unsheathed') the insect is able to draw the ingested food directly into the stomach. In the other method, known as 'discontinuous suction', the ingested food collects first in the diverticula. The function of the diverticula as food reservoirs has long been recognised, and the author finds that the gas contained therein is air, and that these organs have a dual function. Besides acting as food reservoirs they serve as air separators in which 'air locks', between discontinuous sections of fluid food, are separated in order to preclude the entrance of air into the stomach. A selective and voluntary control is exercised by the insects in regard to the aspiration and destination of ingested foods, blood being generally dispatched to the stomach and sugary solutions to the diverticula. The outcome of the experiments described indicates that the essential requirements for ovulation in *A. ægypti* are not only the presence of sperms in the spermatheca, but also the direct reception by the stomach of some essential food (blood). In the case of *C. pipiens* an additional factor, as yet undetermined, is necessary. If unfertilised females of *A. ægypti* take blood by interrupted feeds into the diverticula, ovulation never occurs. If, on the other hand, the blood enters the stomach, activation of the ovaries and oviposition usually take place. When a fertilised female of either species is fed through a capillary tube on blood containing a trace of honey, or other carbohydrate, the blood-honey mixture is diverted into the diverticula, and the food is rapidly digested without any activation of the ovaries.

Apple Scab.—Two papers dealing with work carried out at the Long Ashton Research Station upon this fungus disease of apples, *Venturia inæqualis*, appear in the March issue of the *Journal of Pomology and Horticultural Science* (vol. 9, No. 1). Dr. K. H. Johnstone analyses the varying resistance shown by different varieties of apple to the disease. The importance of an adequate water supply for spore germination of the parasite is emphasised, and it is pointed out that, in this connexion, varietal differences in the ease of wetting of the cuticle surface of the host may be important. Actual thickness of the cuticle presents no barrier to penetration, but in certain varieties an impenetrable quality appears to develop, so that the period of susceptibility is of short duration in these varieties. R. W. Marsh describes lime sulphur spraying experiments carried out on commercial plantations in Somerset, Worcestershire, and Herefordshire to test the conclusion, based on Long Ashton experience, that excellent control could be obtained by spray applications terminating before the time that the flower petals fall. The results were satisfactory on the whole, and, incidentally, observations on spore deposition carried out during these trials suggest that almost all the new infection in the early season comes from pustules from scabbed leaves, not from over-wintered leaves, as had been stated to be the American experience by Keitt and Jones (*Wisconsin Agric. Expt. Station Res. Bull.*, 73, 1926).

The Gold-Belt of Rhodesia.—"The Geology of the Country between Gatooma and Battlefields", in

Southern Rhodesia, is described by A M Macgregor in *Bull* 17 of the Geological Survey of Southern Rhodesia, 1930, pp 144 and maps The area forms the central part of the principal gold belt of Rhodesia and lies between the largest mines of the Colony, the Cam and Motor in the north, and the Globe and Phœnix and Gaika in the south The most ancient rocks are green stones with interbedded sediments that are older than the Rhodesdale Gneissic Granite Next follows a belt of sedimentary rocks which in turn are cut by a series of 'younger' granites and alkali syenites All of these belong to the Basement Complex and are thought to be older than the Great Dyke and of Pre Cambrian age The mineral deposits are almost exclusively gold bearing quartz veins, of which about a hundred and sixty have been worked as small mines, producing gold valued at more than £2,750,000 up to the end of 1929 There was certainly one important period of ore formation during the later stages of consolidation of the 'younger granites, and there may also have been an earlier period Several excellent and detailed analyses of the igneous rocks are presented They disclose an important characteristic which deserves further attention namely, the abnormal richness in strontia in the rocks of three successive igneous cycles Baryta is rare in comparison, and thus the usual proportions of these oxides are reversed to an extent that is unknown elsewhere in the world

Fossil *Metacheiromys* -- G G Simpson, in the *Bulletin* of the American Museum, vol 59, 1931, has given a very full account of the genus *Metacheiromys* The precise position among the mammalia of these animals, which occur in Middle Eocene deposits of the United States, has hitherto been rather uncertain Their affinity to the Edentata has long been suggested, and Simpson now shows that this view is correct Although aberrant in some respects, such as the peculiar and reduced dentition, in others they are very primitive and represent an early side branch of the Xenarthra With regard to the origin of the edentates as a whole, Simpson considers that, with the exception of the Tubulidentates of South Africa, which are probably of proto ungulate stock, the American forms and the Asiatic Manidæ came from some branch of the Insectivora during the Cretaceous period

Active Earthquake-Faults in Tokyo — A comparison of the levellings made in the Tokyo area in 1918 and November 1923 reveals a zone of marked depression of as much as 24 8 in across the section of the city lying east of the river Sumida As no other great earthquake occurred in this interval within 25 miles of Tokyo, the change was probably due mainly to the earthquake of Sept 1, 1923 Since then, two new lines of levels have been carried across the area, in January 1926 and March 1930, the results of which have recently been examined by Prof A Imamura (*Tokyo Imp Acad Proc*, vol 7, pp 1 4, 1931) During each interval, a similar depression occurred in the zone mentioned, which forms a block between two north south faults about 4 miles apart The maximum depression during the first interval was 7 0 in and during the second, 22 0 in, the average secular depression of the district being less than 0 7 in a year During the first interval, no earthquake of any consequence occurred near Tokyo, but during the second, there was a semi destructive earthquake on May 21, 1928, with its epicentre near the sea and close to the eastern of the two faults mentioned Prof Imamura suggests that the earlier of the two depressions was a harbinger, and the later a consequence, of the movement that caused this earthquake As the earthquake that destroyed Yedo (Tokyo) in 1855 seems to have had its origin along the same fault, and as the two faults are not likely to remain inactive, he urges the desirability of keeping a close watch on the movements of the block

Distribution of Ice in the North Atlantic —The International Ice Observation and Ice Patrol Service in the North Atlantic has produced its report for 1930 (*Bulletin* 20, United States Coast Guard) Icebergs appeared off the Grand Banks of New foundland much earlier than usual The cutter *Tampa* began its service about seven weeks earlier than in 1929 owing to the presence of much ice A continuous patrol was maintained for 117 days, which was on the whole longer than usual, although the ice season ended so early as June 10 The conditions, however, were not so severe as in 1929, but the number of bergs was well above the average Only six bergs drifted south of the forty third parallel This is attributed partly to the narrowness of the southward flowing cold stream off the eastern edge of the Grand Banks These six bergs were closely watched by the patrol vessels, and three of them crossed important west bound shipping tracks The usual extension of cold water to the westward round the Tail of the Bank was also absent The report is illustrated by a number of charts showing the distribution of ice and surface temperature during the months of the patrol service

Magnetisation in Strong Fields —Prof P Kapitza's researches on the properties of bodies in very large magnetic fields, well beyond the range of ordinary electromagnets, are extended in new work described in the April number of the *Proceedings of the Royal Society* to the measurement of magnetisation The experimental arrangements are typical of many used by Prof Kapitza, being at once robust and very sensitive, and consist essentially of a magnetic balance with which the whole of the experiment is carried out in about one hundredth of a second, and the results recorded permanently in this time Typical ferromagnetic paramagnetic, and diamagnetic bodies have been studied With iron and nickel it has been shown that the state of saturation produced with relatively small fields persists, within the limit of experimental error (1 per cent) up to fields of 280 kilogauss, a result in accord with the Weiss theory With the para magnetic crystals of gadolinium sulphate—a substance studied exhaustively by Onnes at very low tempera tures— an indication of incipient paramagnetic saturation was obtained at liquid nitrogen temperatures Measurements have also been made upon monocrystalline bismuth This work, extensive and important as it already is, is nevertheless only preliminary, and very interesting results are to be anticipated when the necessary equipment and facilities for using liquid hydrogen and liquid helium as refrigerants have been developed

Pressure of Granular Material — A large collection of data bearing on the properties of granular material, a subject of much technical importance, is contained in a communication from Prof C F Jenkin in the April issue of the *Proceedings of the Royal Society* The work arose from attempts to measure the effective coefficient of friction of sand, some phenomena encountered being immediately recognised as examples of what Osborne Reynolds termed "dilatancy" This suggested certain lines of experiment on pressures on walls built in various ways, and subject to the influence of small bodies packed under different conditions, and the paper deals largely with results so obtained One result of immediate applicability is that the position of the centre of pressure on a wall is

determinate, it may be much higher than one third of the height of the wall, so that the distribution of pressure will often be different from the commonly accepted triangular distribution. The pattern of the packing of the grains is of fundamental importance, and as would thus be anticipated, ground and spherical preparations of a common material behave quite differently. Prof. Jenkin makes an interesting suggestion with regard to the variable nature of some results, which he assumes provisionally to be due to a variable adsorbed film of moisture on the grains.

Diffraction of Electrons in Polyatomic Vapours.—A recent paper by R. Wierl in the *Annalen der Physik* (vol. 8, p. 521) extends the use of electron waves to the study of the arrangement of atoms in polyatomic molecules. The principle of the method employed is that the nuclei of the atoms in each individual molecule are equivalent to a grating with a small number of diffracting elements, an analogous problem for X-rays having been solved by Debye. Electrons are, however, more rapidly absorbed than X-rays of the same range of wave-lengths which is useful for this purpose, so that the time of an experiment can be reduced to a fraction of a second. The apparatus consists essentially of a fine pencil of electrons from a discharge tube or thermionic source, which is made to traverse a beam of molecules passing through the same highly evacuated vessel, and to register its diffraction pattern photographically; the diffraction rings are photometered afterwards. By comparing the observed distribution of intensity with that predicted for various molecular models, considerable information has already been obtained about the structure of a number of organic and inorganic bodies.

Dimensional Changes in Heat-treated Aluminium Alloys.—As a result of a report that heat-treated aluminium alloys were liable to serious secular changes of dimensions during storage, Grogan and Clayton have investigated the point for several such materials and found no appreciable change to occur, the variations which were observed being so small as to be negligible for all practical purposes. Their investigations were described in a paper read on Mar. 12 at the annual general meeting of the Institute of Metals. When the heat-treated alloy is machined, however, considerable changes in the dimensions may be found. These are greatest in the case of *Y* alloy and least in a copper-silicon alloy. Since the annealed bars do not give these effects, it is clear that it is to internal strains due to the heat treatment that the variations are to be ascribed. In *Y* alloy and duralumin, the only alloys examined in this direction, quenching in cold oil reduces the dimensional changes which occur on machining as compared with those resulting from quenching the material in cold water. If the alloys are quenched in boiling water, which is shown to bring about quite satisfactory hardening, the distortion is reduced to relatively small proportions. Tempering subsequent to the hardening reduces the changes in '25 S' alloy, but increases them to a slight extent in the copper-silicon material.

Effect of Firedamp on Inflammation of Coal Dust.—For some time, the mining engineer has distributed stone dust underground as a means of stopping the propagation of coal dust explosions in mines, and rules have been drawn up for regulating the proportion of incombustible material in the mine dust necessary to ensure safety. It is an important question whether the presence of firedamp in the air underground would make the extinction of an explosion more difficult. In a recent paper, No. 64 (H.M. Stationery Office, 6d. net), issued by the Safety in Mines Research Board, experiments on "The Effect of the Presence of Firedamp on the Inflammation of Coal Dusts" are recorded. They showed that the presence of inflammable gas necessitated the use of an increased quantity of stone dust, the proportion depending on the nature of the coal. A coal dust the danger of which is neutralised by an equal quantity of stone dust, when no firedamp is present, would require about 5 per cent more stone dust for each 1 per cent of firedamp in the air.

Fuel Testing in Slow and High Speed Diesel Engines.—Data relating to oil fuel for internal combustion engines have a special interest for the engineer in view of the modern development of the heavy oil high compression engine in small power units both for stationary work and for traction. In a paper read before the Institution of Petroleum Technologists on Mar. 10, L. J. Le Mesurier and R. Stansfield attempted a survey of the behaviour of fourteen different types of fuel when used in slow and high speed engines of low power running under approximately standard conditions. The engines experimented with differ in three main particulars, namely, speed of running, design of combustion space, and arrangement of injection gear for the fuel, although all employ the solid injection system. The programme of work is very wide and includes the effect of leakage of fuel upon the running of the engine, fuel consumption, and the process of combustion. The authors also experimented with various dopes and have indicated the effects of these upon the fuels used. Many graphs and diagrams are published with the paper, among the most interesting being those dealing with the 'delay angle' for each fuel, and also those diagrams indicating the 'combustion line' for each fuel which are obtained from the different engines. The results presented by the authors should be of value to all those interested in the design and performance of the small powered oil engine, and should be suggestive of further work in this direction.

An Improved Metallographic Microscope.—Many improvements tending to secure a high degree of rigidity and ease of manipulation have been embodied in the redesigned Leitz metallographic microscope. The improved optical system gives a very flat field and is provided with a new type of illuminator giving conical illumination, that is, oblique in all azimuths, thus permitting wide angles to be used without the introduction of glare. Another illuminator, consisting of a glass plate and a small lens, can easily be inserted when photographic objectives of short focal length are being used. The mechanical design is such as to minimise so far as possible the necessary movements of the operator in manipulating the apparatus. The transition from visual observation to photographic work is made by rotating the viewing eyepiece. The observer can view the image to be photographed through an opening in the side of the camera without changing his position by the ocular. In addition, a mirror fitted to the camera stand can be used for purposes of demonstration or observation of the image on the ground glass screen. The arc lamp, which has a steady crater, is interchangeable with a filament lamp for use when a less intense source of light is desired. A noteworthy feature of the outfit is the vibration absorbing device on which the prismatic optical bench carrying the saddle stands is suspended. By its use the difficulty of obtaining photomicrographs in rooms subjected to vibration is obviated. Full particulars of the apparatus and accessories may be obtained on application to Messrs. E. Leitz, 20 Mortimer Street, London, W.1.

Optical Experiments with Electrons.*

It is now seven years since L. de Broglie brought forward the view of the duality between waves and particles which is now almost universally accepted under the name of wave mechanics, and represents one of the greatest advances in physics of this or any other century. The original treatment was a development of the theory of relativity, but this side of his theory can no longer be kept in its original form. It appears, in fact, that the requirements of relativity are closely connected with the magnetic properties of the electron which gave rise on the older theory to the idea of a 'spinning electron' and were not considered by de Broglie. I do not propose to deal with these, and shall give the theory in the approximate form which is sufficient to explain the experiments I propose to describe.

The basis of the whole is a duality between waves and particles which is common both to matter and radiation. Maxwell made optics a branch of electricity; if de Broglie has not reversed the relation, he has at least shown both as different cases of a common principle, which is more like old fashioned optics than old fashioned electricity. The duality takes this form: any observable atomic event is representable as the arrival or departure of a particle at or from a small region of space, but the laws which govern this event involve a quantity which is best thought of as the amplitude of a wave (possibly in multidimensional space). In the case of light, this quantity is indeed the electric or magnetic vector of the Maxwell wave (it is indifferent which).

In the case of electrons, it is the more elusive ψ which obeys also an equation of the type known to mathematicians as a wave equation. In general, ψ is complex, for the equation is complex, so no direct physical meaning can be assigned to it. Its modulus $|\psi|$ is real, and de Broglie gives as his 'principle of interference' the statement that the chance of the presence of an electron at a given place and time is proportional to $|\psi|^2$. The analogous statement in optics is that the chance of a quantum of light appearing at a given place and time is proportional to the square of the amplitude of the Maxwell wave.

According to de Broglie's theory, the wave length associated with a free electron is $\lambda = h/mv$ where h is Planck's constant and mv the momentum. He enunciates, therefore, a 'law of spectral distribution', according to which the chance of the presence of an electron with a given momentum is proportional to the square of the modulus of the Fourier component of the wave the wave length of which corresponds to the given momentum. In optics, the chance of the appearance of a quantum of energy W is proportional to the square of the Fourier component of the Maxwell wave of wave length hc/W.

This simple correspondence between electron and quantum—ψ wave and Maxwell wave—in the case of the free electron prepares us for a close experimental analogy. In fact, we can repeat many optical experiments with electrons and get strikingly similar results. The chief differences are due to the smaller wave length, which is usually less than that of X rays, and the much smaller penetrating power. Davisson and Germer made experiments with electrons which are analogous to the diffraction of X rays by a single crystal, as in the Bragg method.

Other experiments have reproduced with cathode rays the diffraction of X rays by a crystalline powder, and have verified de Broglie's law of wave length with considerable accuracy. Some recent work with cathode rays and single crystals of copper and silver provides the electron analogy to the optical experiment in which two transmission diffraction gratings

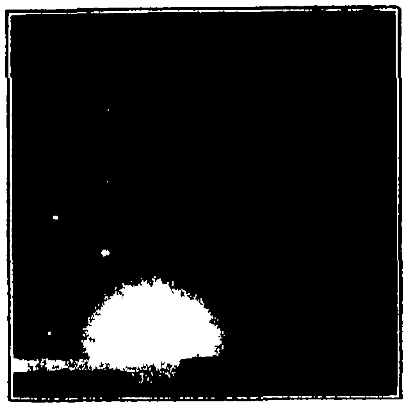

FIG. 1.—Diffraction pattern of cathode rays incident on a cube face of a single crystal of silver.

are superposed with their rulings inclined to each other (Fig. 1). The etched surface of the single crystal is apparently covered with a number of small lumps, probably the material left between etching pits. The cathode rays strike the crystal at a small glancing angle to the main surface, and pass through the lumps, being diffracted by the atoms in them. If the thickness of the lump in the direction in which the rays traverse it, is less than a certain amount, which for the angles of diffraction and electronic wave lengths used is of the order 10^{-6} cm., the thickness has no influence on the pattern. The diffracting system is then equivalent to an arrangement of atoms in the plane normal to the rays, and this two dimensional array is mathematically equivalent to the crossed gratings of the optical experiment, giving rise to an array of spectra which is reciprocally connected with the atomic array producing it.

The spectra, when received on a fluorescent screen, are bright enough to be shown to a small audience.

* From a lecture delivered by Prof. G. P. Thomson, F.R.S., before the Optical Society on May 14.

Indian Fossil Plants

IN 1928, Prof. Sahni produced the first part of an important work on Indian fossil plants. It dealt with the fossil coniferous plant remains found in the form of impressions and incrustations in rocks of the Gondwana System in India. The majority of the fossils described were of Mesozoic age, but there were also a few Palæozoic species of a doubtful nature.

In the second part of the work, which has recently been published,* Prof. Sahni extends his researches to petrified coniferous plants, providing descriptions of much that is new and interesting, as well as revising earlier work on this subject. The material with which

* Memoirs of the Geological Survey of India. *Palæontologia Indica*, New Series, vol. 11. Revision of Indian Fossil Plants. Part 2, Coniferales (b. Petrifactions), by Dr. B. Sahni. Pp. 47-124 + plates 7-15. (Calcutta: Government of India Central Publication Branch, 1931.) 7.0 rupees; 12s.

he deals has been accumulating for many years in the collections of the Geological Survey of India, and some of the specimens are preserved in the British Museum As Prof Sahni remarks, it is unfortunate that the localities and horizons of so many of the specimens are not known with certainty In spite of this serious disadvantage, Prof Sahni adds very considerably to our knowledge of the Coniferales

Most of the petrifactions are of secondary wood and belong to either the Jurassic or Cretaceous age They include the following form genera *Mesembrioxylon*, *Cupressinoxylon*, and *Dadoxylon* (*Araucarioxylon*) It is curious that there is no mention of *Dadoxylon indicum* or *Dadoxylon bengalense* Holden, two palæozoic fossil woods which are certainly gymnospermous, while the latter is as likely to be coniferous, in view of its structure, as any of the Mesozoic species of *Dadoxylon* described by Prof Sahni These two Indian fossil woods are particularly interesting, since they resemble, in certain important characters, species described from the Karroo formation in South Africa Prof Sahni cites this work by Holden in part 1, but does not mention either of these two species

A new genus of cone, *Indostrobus*, is described It bears bract and ovuliferous scales as in the living pine, but differs in the ovuliferous scale being forked at its distal end The seeds are placed on the ovuliferous scale at some distance from the cone axis Prof Sahni recognises features reminiscent of the podocarps in the structure of this cone, but at the same time is clear that it is most closely related to the Pinaceæ He also produces clear evidence of the existence of araucarian conifers in the Jurassic of the Gondwana system The podocarps, if one may judge not only from the various types of fruits and foliage but also from the numerous examples of secondary wood, were abundant and had a wide geographical distribution in India in the Jurassic and Cretaceous

The contrast between the present and past distribution of conifers in India is stressed by Prof Sahni There is only one native conifer in peninsular India at the present day There is no native living conifer in Ceylon The living conifers are restricted, in greater India, to the Himalayas with their connected ranges and to Assam and Burma In the Tertiary Period there is apparently an almost complete absence of conifers in the India floras so far investigated, and the Indian Tertiary floras would appear to have been almost exclusively angiospermous There is only one record of Indian Tertiary coniferous wood and that is from Southern India In the Cretaceous Period the traces of conifers are fairly numerous, but the group appears to have enjoyed its maximum development in the Jurassic It is a remarkable fact that no fossil conifers are recorded from extra peninsular India

On the strength of these facts, Prof Sahni concludes that the conifers were confined in Mesozoic times to peninsular India Later they gradually approached extinction, and when the Himalayas were brought into existence in the Tertiary Period the conditions for coniferous growth were reintroduced and an invasion of the modern coniferous flora took place from the landward borders

From a consideration of their respective floras, Prof Sahni considers that the Parsora Stage of Dr Cotter s 1917 classification of the Indian Gondwana System is of Triassic age, and that the Maleri Stage must be referred to the Upper Gondwanas and not, as has been done previously, to the Lower, for the flora suggests an age at least as late as the Rhætic He considers that while it is clear that Ceylon and the Madras region formed part of the same palæobotanical province in Upper Gondwana times, it is possible that the flora of the Mesozoic plant beds of the Southern Shan States had a closer connexion with the contemporaneous floras in China than with the Indian Upper Gondwana floras

Valuable synoptic charts and distribution maps are given One of the many outstanding good qualities of these memoirs is the excellence of the illustrations and by means of these the evidence is put before the reader in a manner which leaves little to be desired All palæobotanists and those geologists who are interested in the stratigraphy of the Indian Gondwana System will look forward to the extension of Prof Sahni's researches to the other groups of Indian fossil plants

Physics in Relation to the Internal Combustion Engine *

THE development of all internal combustion engines using gas or oil as a fuel and for all duties, whether stationary on land or for transport, road, marine, or in the air, owes more to the guidance of physics than any other prime mover

In the first period, when the engine was nearly always a gas engine, the investigation of the processes which governed its action and the limitation of its cycle of working were carried out by physicists like Sir Dugald Clerk, Prof Hopkinson, and others The results assisted and accelerated development making possible the extended use of the engine for all industrial purposes that followed

Perhaps the outstanding feature during this time was the growth of the engine in size, until ultimately engines using the waste gases from blast furnaces were built, or are building, for powers so large as 10,000 h p per engine These large size engines are found usually abroad, operating in the most efficient iron and steel works As regards the smaller sizes in Great Britain, they would have been used more widely if the gas industry had foreseen the possibilities of a country wide gas supply with interconnecting trunk mains, as has been done since by the electrical industry

The War period followed, and led to an intensive and rapid development in the engine for transport, in particular in the air, where special materials and increased accuracy of workmanship were called for The extraordinary progress made was largely due to the number of highly trained physicists and engineers who concentrated upon every problem and solved it as it arose

Since the War, development has been in the use of oil, and the wide adoption of the engine for marine propulsion has been due to the high economy of the Diesel motor The high economic possibilities of this engine were thoroughly discussed in a paper by Diesel before the engine was actually built, and though it took many years to bring this into practice the results have justified all that he had proposed At the present time, development is being concentrated upon the high speed oil motor using relatively cheap fuel, with the added advantage of reducing the risk of fire, for road transport and for the air, and very good progress is being made

The first 'safety first' engines to fly regularly were those supplied to the airship *R101* Since then one has flown in the United States and one in Germany, and these will shortly be followed by another type in Great Britain

On the road, extraordinary progress has taken place in the application of the small engine to motor lorries,

* From a lecture delivered by Alan E L Chorlton before the Institute of Physics on May 19

etc , the economy with cheaper fuel and using less of it has been so marked This class of engine has called for the most intensive investigation and research that has ever been carried out in the internal combustion engine world Much valuable laboratory work has been carried out in the United States by the National Advisory Committee for Aeronautics in connexion with their air work, and elsewhere

This reveals the intensity of effort which will before long ensure that not only will the oil engine become predominant for road work of heavier nature, but also for the air, where its great safety from the fire risk, coupled with its economy, makes it so highly suitable The use of coal dust in the engine progresses very slowly for a country like England, the industrial supremacy of which is founded on coal This is to be regretted, and we should conduct special work with this object

In all the development of the engine, the steady improvement of the material has been the measure of the progress made To day we have new steels practically unwearable—allowing high speeds and long life, and also of such strength that motors like the Schneider Cup engine weigh less than 1 lb per h p —and a degree of excellence of workmanship not ex celled, if equalled in all the world

University and Educational Intelligence

Birmingham At the annual degree congregation on July 4, the honorary degree of M Sc is to be conferred on the following R A Chattock, formerly chief electrical engineer to the City of Birmingham, W Wickham King, known for his work on the Permian breccia, J H Reynolds, who has made a special study of the nebulæ, and J J Shaw, known for his seismo logical work

Prof J C Brash is resigning his posts as professor of anatomy and dean of the Faculty of Medicine on being appointed to the chair of anatomy in the University of Edinburgh

Cambridge —A meeting of the electors to the Sadleirian professorship of pure mathematics will be held on June 12 The stipend of the professor is £1200 a year or, if he holds a fellowship with dividend, £1000 a year Candidates are requested to communi cate with the Vice Chancellor on or before June 2

A University lectureship in the faculty of mathe matics is vacant An appointment to it will be made in the current term, to take effect from Oct 1 Candidates are requested to send their names, with any evidence of qualifications which they may desire to submit, to Mr W J Harrison, Secretary of the Faculty Board of Mathematics, Clare College, Cam bridge, on or before May 30

The General Board recommends that an additional University demonstratorship be established in the Department of Zoology

Prof G Elliot Smith, professor of anatomy in University College, London, has been elected an honorary fellow of St John's College

London —At a meeting of the Court of the Univer sity held on May 13, the Principal, Dr Edwin Deller, read his annual report of the work of the University for the year 1930–31 The statistics for that year have brought out some striking facts concerning the number of students For example, the number of matriculations has almost quadrupled since just before the War A great increase has taken place in all branches of study For the year 1913, the numbers of matriculations, first degrees, and higher degrees were 6638, 1636, and 171 respectively The corresponding numbers for 1929 were 23,832, 3436, and 510, and for 1930, 25,544, 3543, and 548 The total number of degrees, diplomas, and certificates awarded for those three years were 11,937, 36,633, and 39,323 During the last decade, the inspection and examination of secondary schools have received much attention, and the growth of the school examinations has been specially noteworthy

The Goldsmiths' Company has offered the Univer sity a sum not exceeding £50,000 towards the cost of erecting and equipping the library building on the Bloomsbury site The University library, at present housed in the Imperial Institute, South Kensington, contains a total of some 260,000 volumes and pamph lets, and includes, with other special collections, the Goldsmiths' Library of Economic Literature

Applications for grants from the Research Fund of the Chemical Society must reach the Assistant Secretary of the Society, Burlington House, W 1, by June 1, and be made upon special forms obtain able upon application

Applications are invited by the London County Council for two Robert Blair fellowships in applied science and technology, each of the value of £450 and for one year The fellowships will be tenable in the Dominions, the U S A or other foreign countries, and are open only to British subjects of not less than twenty one years of age Particulars and application forms can be had from the Education Officer (T 3), The County Hall, S E 1 The latest date for the return of forms of application is June 18

A number of post graduate scholarships in agri culture and agricultural science and in veterinary science respectively will shortly be awarded by the Colonial Office The scholarships, which will each be of the annual value of £250, plus £12 for books, have been instituted with the view of ensuring a supply of adequately trained men for future service in the Colonial Agricultural and Veterinary Services Re quests for particulars of the scholarships and for the necessary forms of application should be addressed to the Director of Recruitment (Colonial Service), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 The latest date for the return of completed forms is June 15

The twenty second annual Conference of the Association of Teachers in Technical Institutions will be held at Manchester on May 22 26, under the presidency of Mr H Ade Clark The Conference will be held at the College of Technology In connexion with the Conference an exhibition of machines, scien tific apparatus, and books will be opened on May 25 Among the resolutions for public sessions is the motion that a representative of technical education should be appointed to the Consultative Committee of the Board of Education The teaching of biology, too, will receive consideration A considerable amount of biology is taught in many technical schools and colleges, but this is chiefly of a purely technical char acter for the benefit of pharmaceutical chemists The resolution to be placed before the Conference, how ever, will be of a wider nature It is considered that a knowledge of biology is an essential part of a sound general education, and that more experts in the subject are required for the advancement of agriculture and industry The Conference is to ask for the teaching of elementary biology in all State aided schools and an increase in the facilities for higher education in bio logical subjects The latter is scarcely necessary The facilities are there, but the former really needs attention A better groundwork in the younger pupils is certainly desirable Much has already been sug gested concerning it; but little, so far, has been done.

Birthdays and Research Centres

May 24, 1855.—Dr. A. C. HADDON, F.R.S., formerly reader in ethnology in the University of Cambridge.

At present I am engaged in compiling published and unpublished information concerning the sea canoes of Melanesia, New Guinea, and North Queensland. The original craft are, in many areas, fast disappearing or becoming modified, and in some places have quite disappeared. Not only do these canoes often exhibit remarkable technical skill and adaptability to local circumstances, but also considerable diversity. The distribution of the various types and details of construction of these vessels is worth recording, since these were the means by which the various migrations and culture drifts have spread over western Oceania. The names for canoes and their various parts are significant in this connexion. Very little has been recorded about the traditional relation between definite types of canoes and culture-heroes or culture drifts. It is hoped that a foundation will be provided upon which other ethnologists may build.

May 24, 1860.—Prof. A. SMITHELLS, F.R.S., director of the Salters' Institute of Industrial Chemistry and emeritus professor of chemistry in the University of Leeds.

So far as research work is concerned, I continue with the study of some flame problems and, with a long-standing connexion in the gas industry, with scientific investigations relating to the carbonisation of coal and the use of gaseous fuel. The advances that are being made by this branch of our fuel industries in the application of science to its technical problems, and the results which have accrued from industrial research conducted by the gas industry and the benzol industry in association with the University of Leeds, are, I think, notable. The national importance of directing research to fuel problems on every side scarcely needs emphasising in the columns of NATURE.

May 25, 1858.—Sir HENRY MIERS, F.R.S., honorary professor of crystallography and lately vice-chancellor of the University of Manchester.

The splendid results of X-ray methods will not, I hope, distract attention from two promising lines of research in mineralogy and crystallography. (1) Experimental mineralogy: that is, the artificial production of minerals, both rock-forming and others, and the study of their origin and transformations. The lack of a geophysical laboratory in Great Britain has long been deplored. (2) Crystal growth: that is, the study of the conditions which prevail in and upon the surface of the growing crystal; these determine its actual form; perhaps also its external symmetry, as some believe.

May 25, 1865.—Prof. P. ZEEMAN, For.Mem.R.S., professor of experimental physics in the University of Amsterdam.

My co-workers and I are at present most interested in the experimental study of the influence of magnetic fields on the hyperfine structure of spectrum lines. Values of the mechanical moment of the atomic nucleus obtained from such magneto-optical resolutions are among the most important data for the further development of the quantum theory. A second line of work, concerning the more detailed analysis of the light given out by positive rays, which, as Stark and Lunelund have shown, is partially polarised, is in the charge of Miss W. Lub. An extensive study, made in my laboratory, of the magnetic resolutions of the spectra of the ionised noble gases, will soon be published by Mr. Bakker.

Constant progress is being made in the analysis of different spectra, especially by Dr. de Bruin.

May 28, 1861.—Dr. H. R. MILL, vice-president and formerly librarian of Royal Geographical Society and president of Section E (Geography) of the British Association in 1901, past president of Royal Meteorological Society and Director of British Rainfall Organization.

I worked long at researches preliminary to the construction of an accurate map of the normal annual rainfall of the British Isles, and I hope that the work will be continued and completed by better equipped and more fortunate investigators.

The practical problem present to my mind is to draw isohyets of the average annual precipitation from air currents impinging horizontally on land slopes. Such a map would express exactly the control of a mobile distribution by crustal configuration undisturbed by the sporadic precipitation produced by ascending air currents of purely aerological origin occurring in cyclones, squalls, and thunderstorms. Centuries of observations would be required to produce a map of total rainfall in which such sporadic splashes would be smoothed out; but I believe that a method of eliminating these irregularities in shorter periods might be deduced from the study of very detailed maps of individual showers together with equally detailed synchronous maps of atmospheric pressure.

May 29, 1882.—Prof. H. BATEMAN, F.R.S., professor of mathematics, physics, and aeronautics in the California Institute of Technology, Pasadena, California.

My chief investigation now in progress is on reflection at an absorbing wall of the sound from a point source.

Societies and Academies.

LONDON

Royal Society, May 7.—**M. D. Waller:** (1) The measurement of actinic erythema produced by ultra-violet radiation with special reference to the latent time. Consistent results regarding the biological action of ultra-violet radiation, as measured by the resulting skin erythema, can be obtained provided certain precautions are taken. The latent time of erythema, which may vary from about one to seven hours, according to the length of exposure, provides the most accurate and simple way of estimating the effect of ultra-violet radiation on the skin, and it is easily measured. When it is desired to get the maximum contrasts due to differing conditions of radiation, exposures should be chosen which will lie on the steep part of the curve, corresponding to rapid variations of the latent time with exposure and to slight erythemas which will differ even visually one from another more than will deep erythemas.—(2) The relation between energy doses of ultra-violet radiation and actinic erythema produced. Particular attention was paid to the question of how the intensity of the radiation decreases with the distance from the source. The intensities were varied over wide limits (200 : 1) corresponding to distances varying from 40 cm. to 5.5 m. The effect of a given dose of the weak intensity is just as great as that of the most powerful intensity used, and it is concluded that the production of erythema follows the Bunsen-Roscoe law for a

photo chemical action, that is, the time factor is unity —**J W Tudor Thomas** On the return of sensitiveness in corneal grafts in rabbits In a series of experiments on corneal grafting, some of the grafts became sensitive and others did not The results of 29 experiments are analysed Some of the grafts were central in position in the cornea, others marginal Some remained or became clear, others became more or less opaque, while one exhibited a central clear area The establishment of an afferent nerve supply to a corneal graft depends upon a precedent or concurrent growth of blood vessels in that graft It does not seem to be necessary that the blood vessels should accompany or take the same path as the afferent nerves that grow in from the surrounding tissue —**G E Briggs** and **A H K Petrie** Respiration as a factor in the ionic equilibria between plant tissues and external solutions The conductivity of water containing slices of tissue from carrot root rises at first and then falls to a steady value, which is maintained as long as the tissue is alive The rate of evolution of carbon dioxide by the system follows a similar course to that of the conductivity Theoretical consideration shows that variations in the rate of production of carbon dioxide by the tissue will be accompanied by similar changes in the concentration of hydrogen ions in the tissue This will result in changes in the degree of ionisation of indiffusible substances, such as proteins with consequent changes in the distribution of diffusible ions, such as K and Cl between the tissue and the external solution The final result of this chain of events will be a parallelism between rate of production of carbon dioxide and conductivity of external solution **McKeen Cattell, T P Feng, W Hartree, A V Hill,** and **J L Parkinson** Recovery heat in muscular contraction without lactic acid formation Muscles poisoned with iodo acetic acid contract without producing lactic acid Functional recovery in oxygen after stimulation can be demonstrated under certain conditions *in such muscles* The *persistence* of this 'recovery' heat suggests that one effect of iodo acetic acid is to interfere with the mechanism by which energy released in oxidation can be employed in driving the endothermic reactions necessary for functional recovery, it does not interfere with oxidation as such Normal muscles stimulated to extreme exhaustion have a 'recovery' heat only about one quarter of its usual value in relation to the initial heat Possibly in normal muscles pushed to extreme exhaustion as in muscles poisoned with iodo acetic acid one reason of incomplete recovery is that phosphate set free by the breakdown of creatine-phosphoric acid is 'side tracked' as hexose phosphoric ester and so cannot be recombined with creatine **A G R Whitehouse** Further investigation of sweating and sweat For a given rise in body temperature, sweating is facilitated by the performance of muscular work when compared with sweating produced by the same rise in body temperature with the subject at rest Some product of muscular metabolism is responsible for this, though the connexion may be a less direct one The performance of a moderate amount of work would seem to be accompanied by little rise in the chlorine concentration of the sweat, although a marked increase with time, indicative of fatigue of the sweat glands, is evident when the subject is at rest and the sweating is simply due to the wet bulb temperature of the surrounding air A progressive decrease in the proportion of organic matter to ash is observed as the sweating continues The chlorine concentration, and also the ratio of chlorine to potassium in the sweat is found to vary for different individuals —**R Snow** Experiments on growth and inhibition (2) In decapitated pea seedlings, which have produced two equal shoots springing from the axils of the cotyledons, if one of the shoots is deprived of its leaves until only those of 1 mm or less remain, it is rapidly arrested in growth and finally killed This effect must be due to inhibition coming from the other shoot The influence coming from developing leaves kills (directly or indirectly) those shoots or parts of shoots that are not in the line between developing leaves and roots and in which it travels towards the apex, and this fact also suggests that it is of a polar nature

Geological Society, April 22 —**H H Thomas** and **W Campbell Smith** Xenoliths of igneous origin in the Trégastel Ploumanac'h granite, Côtes du Nord France In the neighbourhood of Trégastel, a red porphyritic biotite granite crops out along the coast and forms the rising ground for several miles inland In parts, this granite is remarkable for the abundance of xenoliths which it contains Some of these are of sedimentary origin, but the majority are of the kind usually referred to as 'basic segregations' The occasional presence of large felspars in the xenoliths is discussed, and the authors are of opinion that these are xenocrysts and have not grown in place Evidence is produced to show that the basic mass from which the xenoliths were derived was most probably part of the roof of the granite —**C I Gardiner** and **S H Reynolds** The Loch Doon 'granite' area, Galloway The plutonic rocks are almost everywhere surrounded by high hills composed of metamorphosed Ordovician sediments Analyses were prepared by Mr E G Radley of each of the three rock types The most interesting problem concerning the plutonic mass is *to determine the mutual relations of the rocks* and to ascertain whether their different varieties may be considered to have arisen by differentiation subsequent to intrusion, or whether the facts point to each of the three rock types being a separate intrusion The authors believe the latter to be the true explanation No evidence was found of contamination of the igneous magma by the incorporation of sedimentary material

PARIS

Academy of Sciences, April 7 —**Charles Camichel** and **Léopold Escande** An experiment of Joule concerning the mechanical equivalent of heat —**A Gelfond** The order of $D(\lambda)$ — **G A Boutry** Cycles and lag in photoelectric cells with a gaseous atmosphere —**J Barbaudy** and **A Petit** Study of the buffer effect in nickel plating baths —**E Herzog** and **G Chaudron** The protection of iron plunged into aerated saline solutions and the realisation of an Evans battery —**L Meunier** and **M Lesbre** The action of electrolytes upon substantive colouring matters —**H Forestier** The ferrites the relation between their crystalline structures and their magnetic properties The magnetic properties of the ferrites have been shown previously to fall into different groups The X-ray study of the crystalline structure of these compounds proves a direct relation between the crystalline structure and the magnetic properties —**Maurice Marie Janot** Sclareol and its derivatives The formula $C_{17}H_{30}O_2$, provisionally given to the solid alcohol obtained from *Salvia sclarea*, is now found to be $C_{20}H_{36}O_2$ This results from a purer product and is confirmed by the preparation and analysis of a dihydrosclareol —**Louis Lecoq** The complex salts of gold and sodium derived from camphodithiocarboxylic acid —**Acolat** Physiological researches relating to the separation of the venous blood and arterial blood in the frog's heart The peculiarities of the structure of the frog's heart described in an earlier paper

(*C R*, 192, p 767) suggested that the separation of the two bloods in the ventricle is nearly complete Confirmatory evidence is now given, based on the use of a coloured Ringer-Locke physiological liquid —**R Fabre** and **H Simonnet** Researches on beer yeast The experimental conditions of its action on cystine —**A Boutroux** The influence of lipoids on the separation of the proteins by neutral salts —**Paul Durand** *Rhipicephalus sanguineus* and the virus of the pustular fever of Tunis In Tunis, as in the Midi (France), apart from any connexion with human cases, *Rhipicephalus sanguineus* can harbour the virus of pustular fever and keep it intact for several weeks —**P Delanoë** The merion (*Meriones Shawi*) as a reservoir of the Moroccan spirochæte *Sp hispanicum*, var *marocanum* Out of twenty one merions, two were found to be infected, or about 10 per cent, but the exact proportion of infected merions can only be settled by further work It is, however, certain that this rodent can be spontaneously infected by the Moroccan spirochæte

GENEVA

Society of Physical and Natural History, Dec 20 —**L A Deshusses** and **J Deshusses** Estimation of the active principles of pyrethrum The authors have studied pyrethrums of Swiss, French, Spanish, and Dalmatian origin, estimating the two active pyrethrins which give a direct measure of the efficiency of pyrethrum insecticides All these products contain about the same proportions of the active principles, the maximum having been furnished by French pyrethrum cultivated at Bossey (Haute Savoie) and at Montpellier For each of these products, the fully opened flower always gives a much higher percentage than the half opened flower, and the latter more than the closed flower —**E Cherbuliez, F Neumeier,** and **H Lozeron** Some synthetic substituted ephedrins The authors give results of a pharmacological study of some synthetic derivatives of ephedrin, showing how the specific action of this alkaloid is profoundly modified by slight changes of constitution **E Cherbuliez** and **M Schneider** The non homogeneity of casein Casein, hitherto considered as a homogeneous substance, has been separated by physical methods into at least two constituents This necessitates a modification of the current views on the physiological formation of this important substance and on the phenomena of its precipitation by rennet —**E Cherbuliez** The behaviour of two antipodes in an unsymmetrical solvent The author has examined the behaviour of two antipodes in a solvent constituted for the two antipodes dissolved by the same active substance A difference between the properties of the two antipodes is not shown by the solubilities, but, on the other hand, racemisation in presence of the active solvent appears to lead to an active body, and this proves a difference in the reaction of the two antipodes in solution, in spite of the absence of chemical combinations in the ordinary sense of the word —**R Wavre** A measure of the deformation of a fluid By an analysis based on the functional calculus, the author expresses more exactly the ideas of the deformation of a fluid, in order to obtain more rigid definitions of the stability of the states of a system depending on an infinity of parameters The object of this is to study the changes of form that the earth may have undergone in the course of ages, influenced as it is by the solar lunar attraction —**W H Schopfer** An active substance found with maltose Its physiological action The author shows that along with maltose there occurs a nitrogenous impurity, probably a vitamin it accelerates the development of fungi

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Edinburgh, Session 1930-1931 Vol 51, Part 1, No 3 On some Problems involving the Persymmetric Determinants By J Geronimus Pp 14 18 6*d* Vol 51 Part 1 No 4 A Note on the Secular Changes of Rock Temperature on the Calton Hill By Dr F J W Whipple Pp 19-24 6*d* Vol 51, Part 1, No 5 Secular Changes of Rock Temperature—Note on Dr Whipple's Paper By R W Wrigley Pp 25 26 3*d* (Edinburgh Robert Grant and Son London Williams and Norgate, Ltd)

The Transactions of the Entomological Society of London Vol 79, Part 1 April 24 Pp 247 (London) 21*s*

Dove Marine Laboratory, Cullercoats Northumberland Report for the Year ending June 30th, 1930 Edited by Prof Alexander Meek (New Series 19) Pp 68 (Newcastle on Tyne Armstrong College) 5*s*

Government of India Department of Industries and Labour (Public Works Branch). Irrigation in India Review for 1928–29 Pp 87 (Calcutta Government of India Central Publication Branch) 1 2 rupees, 2*s*

India Meteorological Department Scientific Notes Vol 1, No 8 Monthly Normal Isobars and Wind Roses at 0 5, 1, 2 and 3 km above Sea level over India and Neighbourhood Pp 109 112+48 plates 4 rupees 6*s* 9*d* Vol 3 No 20 Correlation between Rainfall in N W India and Height of Indus River at Bukkur By Rao Saheb Mukund V Unakar Pp 15 20+2 plates 6 annas 8*d* Vol 3 No 21 Upper Air Circulation over India and its neighbourhood up to the Cirrus Level during the Winter and the Monsoon By H C Banerjee and Dr K R Ramanathan Pp 21 27+13 plates 2 rupees 3*s* 6*d* (Calcutta Government of India Central Publication Branch)

Report of the Haffkine Institute for the Year 1929 By Major J A P Anderson Pp 69 (Bombay Government Printing and Stationery Office London High Commissioner for India) 4 annas 5*d*

Department of Scientific and Industrial Research Building Science Abstracts Vol 4 (New Series) No 3 March Abstracts Nos 397 584 Pp 71 105 (London H M Stationery Office) 9*d* net

University College of Wales, Aberystwyth Leaflet Series S No 2 New Varieties and Strains from the Welsh Plant Breeding Station No 2 Pure Line Strains of Ceirch Llwyd (*Avena Strigosa*) and Ceirch du bach (*A sativa*). By E T Jones Pp 26 (Aberystwyth) 1*s*

The National Physical Laboratory Report for the Year 1930 Pp vi+295+16 plates. (London H M Stationery Office) 12*s* 6*d* net.

Commonwealth of Australia. Fourth Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1930 Pp 51 (Canberra H J Green)

Report of the Twentieth Meeting of the Australian and New Zealand Association for the Advancement of Science, formerly known as the Australasian Association for the Advancement of Science Brisbane Meeting May-June 1930 Edited by Dr D A Herbert Pp xlviii+596 (Sydney N S W Australian and New Zealand Association for the Advancement of Science)

The University of Leeds Department of Coal Gas and Fuel Industries Report of the Livesey Professor (J W Cobb) for the Sessions 1928 29 and 1929-30 Pp 15 (Leeds)

A 21 Years Chronology of Textiles 1910-1931 Pp. 67+51 plates (Manchester The Textile Institute) 5*s*

The Empire Forestry Handbook, 1931 Edited by Fraser Story Pp 189 (London Empire Forestry Association) 3*s* 6*d*

Stonyhurst College Observatory Results of Geophysical and Solar Observations 1930 with Report and Notes of the Director Rev E D O'Connor Pp xxv+49 (Blackburn)

McGill University Economic Studies National Problems of Canada No 15 The Alberta Coal Problem By Herbert Leighton Draper Pp 65+viii 75 cents No 16 The Negro in Canada. By Ida Greaves Pp 79 75 cents (Orillia Ont. The Packet Times Press Ltd)

Commonwealth Bureau of Census and Statistics Canberra Official Year Book of the Commonwealth of Australia No 23, 1930 Prepared under instructions from the Minister of State for Home Affairs by Chas H Wickens Editor John Stonham Pp xxxii+896 (Melbourne H J Green) 5*s*

The Scottish Forestry Journal being the Transactions of the Royal Scottish Forestry Society Vol 45, Part 1 March Pp xvi+121+2 (Edinburgh Douglas and Foulis) 7*s* 6*d*

Royal Astronomical Society List of Fellows and Associates 1931 March Pp 54 (London)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1364 (Ae 492—T 3030) The 5 ft Open Jet Wind Tunnel, R A E By F B Bradfield Pp 11+11 plates (London H M Stationery Office) 1*s* net.

Ministry of Transport Report of the Committee on Main Line Railway Electrification, 1931 Pp. 57 (London H M Stationery Office) 3*s* net

FOREIGN

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science. Circular Bulletin No 135 Chestnut Blight in Michigan. By D V Baxter and F C Strong Pp 18 Special Bulletin No 207 Public Health and Educational Services in Michigan By C R Hoffer Pp. 84 Special Bulletin No 208 Services of Institutions and Organizations in Town Country Communities By C R Hoffer and Margaret Cawood Pp. 37 Special Bulletin No 209 Consumer Demand for Apples in Michigan By H P Gaston Pp. 50 Special Bulletin No 210 Corn Growing in Michigan By H C Rather and J R Duncan Pp 85 Special Bulletin No 212 School Financing in Michigan a Plan to Equalise the Burden By F M Thrun Pp 79 Special Bulletin No 213 Investigations with Oat Varieties and Diseases in the Upper Peninsula. By B R Churchill Pp. 15 Technical Bulletin No 110 A Contribution to the Bacteriology and Pathology of the Bovine Udder By L B Sholl and J P Torrey Pp. 31 (East Lansing, Mich)

Carnegie Institution of Washington Classified List of Publications Pp 208 (Washington D C Smithsonian Institution)

Smithsonian Institution United States National Museum Bulletin 82 A Monograph of the Existing Crinoids By Austin Hobart Clark Vol 1 The Comatulids Part 3 Superfamily Comasterida Pp vii+816+82 plates (Washington, D C Government Printing Office) 2 dollars

Bulletin of the American Museum of Natural History Vol 61, Art. 5 Dolichopids of the Canal Zone By M C Van Duzee Pp 161 205 Vol 61, Art 6 New North and South American Ascidians By Willard G Van Name Pp 207 225 (New York City)

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts, Vol 8 No 2 Pp ii+89-65+5 10+plates 8 17 (Tokyo National Research Council of Japan)

The Egyptian University the Faculty of Medicine Publication No The Bibliography of Schistosomiasis (Bilharziasis), Zoological Clinical and Prophylactic By Dr Mohamed Bey Khalil Pp x+506 (Cairo) 30 P T 6s net

Scientific Papers of the Institute of Physical and Chemical Research Nos 294 296 On the Absorption Spectra of Salt Solutions—Appendix The Absorption Spectra of Metallic Ions by Seichi Kato The Near Infra Red Arc Spectrum of Iodine by Tatsuro Iwama, Note on the Ultra Violet Absorption Spectrum of Hydrazine Vapour, by Sunao Imanishi Pp 101 167+plates 7 9 (Tokyo Iwanami Shoten) 30 sen

U S Department of Agriculture Technical Bulletin No 230 *Macrocentrus gifuensis* Ashmead a Polyembryonic Braconid Parasite in the European Corn Borer By H L Parker Pp 63 (Washington, D C Government Printing Office) 15 cents

The Science Reports of the Tohoku Imperial University, Sendai, Japan Fourth Series (Biology) Vol 6 No 1 Pp 162 (Tokyo and Sendai Maruzen Co, Ltd)

Bulletin of Yale University Supplement Report of the Director of Peabody Museum for the Academic Year 1929 1930 Pp 23 (New Haven, Conn)

The Peabody Museum of Natural History Yale University Special Guide No 1 The Evolution of the Horse Family By Richard Swann Lull Revised edition Pp 81 15 cents Special Guide No 2 The Evolution of the Elephants and Mastodons By Richard Swann Lull Revised edition Pp 40 15 cents (New Haven, Conn)

Annales de l Institut Henri Poincaré Vol 1, Fascicule 2 Pp 77 208 (Paris Les Presses universitaires de France) 35 francs.

Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol 29 Part 3 The Ascigerous Forms of some Graminicolous Species of Helminthosporium in Japan By Seiya Ito and Karue Kuribayashi Pp. 85 125+plates 7 9 Vol 31, Part 1 Beitrag zur Kenntnis der Pickelwirkung Von Satoshi Sawayama Pp 17 (Tokyo Maruzen Co, Ltd)

Ministry of Agriculture, Egypt Technical and Scientific Service Supplement to Bulletin No 100 Developments of the Existing System for Seed Supply of Cotton in Egypt. By Dr W Lawrence Balls. Pp 17 (Cairo Government Press) 1 P T

Smithsonian Miscellaneous Collections Vol 85, No 2 The Avifauna of the Pleistocene in Florida By Alexander Wetmore (Publication 3115) Pp 41+6 plates (Washington, D C Government Printing Office)

Proceedings of the United States National Museum Vol 78, Art 20 A new Parasitic Fly of the Genus Chaetophlepsis By R. T Webber (No. 2868) Pp 4 Vol 79, Art. 7 Descriptions of New Genera and Species of Siamese Fishes By Hugh M Smith (No 2878.) Pp 48 Vol 79, Art 8 A new Shipworm from Venezuela By Paul Bartsch (No 2874) Pp 3+1 plate (Washington, D C Government Printing Office)

U S Department of the Interior Office of Education Bulletin, 1931 No 20 Biennial Survey of Education in the United States, 1928-1930 Chapter 10 Hygiene and Physical Education By Marie M Ready and Dr James Frederick Rogers Pp 27 (Washington, D C Government Printing Office) 5 cents.

Proceedings of the United States National Museum Vol 78 Art 4 Cambrian Bivalved Crustacea of the Order Conchostraca By E O Ulrich and R. S Bassler (No. 2847) Pp 130+10 plates Vol 78, Art 16 Report on the South American Sea Stars collected by Waldo L Schmitt. By W K Fisher. (No 2859) Pp. 10+8 plates (Washington D C Government Printing Office)

CATALOGUES.

The Bureau of Information on Nickel Air, Oil and Water Coolers the Influence of Design and Materials upon Service By H E Upton (Nickel, R5) Pp 7 (London The Mond Nickel Co, Ltd)

List of Cheap Books in many branches of Science and Natural History (No 166) Pp. 16. (London: Dulau and Co., Ltd)

B D H Ureameter Outfit. Pp. 4. Gaster Siccata B D H (Desiccated Stomach.) Pp. 8. (London: The British Drug Houses, Ltd)

Annotated and Classified Catalogue of Ancient and Modern Books on Exact and Applied Science. Part 1 Including Periodical Publications, General and Collected Works, Mathematics. (Sotheran s Price Current of Literature, No. 825) Pp 152 (London Henry Sotheran, Ltd)

A New Refractometer for examining Sugar Solutions, Jams, Butters Oils and Fats. Pp 8. Refractometers for Industry and Research Pp 12. (London Bellingham and Stanley, Ltd)

Diary of Societies.

FRIDAY, MAY 22

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) (Annual General Meeting), at 6 15.—Exhibition of a Cinematograph Film The Story of Bakelite Resinoid

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7 30.—Dr J T Dunn Chairman s Address.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir William Bragg X Ray Investigations of the Structure of Liquids.

TUESDAY, MAY 26

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 —Annual General Meeting

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30 —Gossip Meeting.

WEDNESDAY, MAY 27

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5 —Annual General Meeting

SOCIETY OF SWEDISH ENGINEERS IN GREAT BRITAIN (at Swedish Chamber of Commerce, 14 Trinity Square, E C 3) at 8 —A F Enstrom Research in Industry and Rationalisation

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London), at 8 30 —Dr R. Money Kyrle The Remote Consequences of Psycho Analysis on Individual, Social and Instinctive Behaviour

THURSDAY, MAY 28

ROYAL SOCIETY OF MEDICINE (Urology Section) (Annual General Meeting), at 8 30 —A R Thompson Further Considerations Relative to Congenital Deformities of the Lower Urinary Tract

FRIDAY, MAY 29

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5 —Annual General Meeting

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section) (Annual General Meeting), at 8 —Sir William Hamer The Crux of Epidemiology

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Very Rev Dean Inge The Future of the Human Race

SATURDAY, MAY 30

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (Annual General Meeting) (at Cambridge)

PUBLIC LECTURES.

FRIDAY, MAY 22

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Prof E L Collis Industrial Hygiene Respiratory Diseases.

BIRKBECK COLLEGE at 5 30 —Sir Henry Hadow The Philosophy of Lord Haldane (Haldane Memorial Lecture)

TUESDAY, MAY 26

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary s Hospital, W 2), at 5 —Col S P James The New Method of Studying Malaria and Some of its Results

WEDNESDAY, MAY 27

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr R. H Crowley Child Guidance

BEDFORD COLLEGE FOR WOMEN, at 5 15 —Prof A O Lovejoy Knowing and its Place in Nature (Succeeding Lectures on May 28 and 29)

KING S COLLEGE, LONDON at 5 30 —Dr W Rosenhain Some Impurities in Metals and the Production of Metals of High Purity (Armourers and Brasiers Company Lectures). (Succeeding Lectures on June 3 and 10)

THURSDAY, MAY 28

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr F C Shrubsall Mental Deficiency from the Social, Legal, and Educational Aspects

FRIDAY, MAY 29

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —N Howard Mummery An Industrial Welfare Scheme

SATURDAY, MAY 30

UNIVERSITY COLLEGE, LONDON, at 2 30.—Sir Flinders Petrie The City of the Shepherd Kings (*To be repeated on June 2 at 5 30.*)

CONFERENCES.

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ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (at Manchester).

Monday, May 25 (at College of Technology), at 10 30 A M.—Induction of President (H Ade Clark).—Presidential Address.

MAY 25 TO 28

DEUTSCHE BUNSEN GESELLSCHAFT (at Vienna).—Subjects for discussion Metallography, Crystal Structure, Thermodynamics, Spectroscopy, Adsorption, and Free Radicals

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CONFERENCE ON MENTAL HEALTH (at Central Hall, Westminster)

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Thursday, May 28, at 3 —The Human Factor in Crime.
At 8.15 —The Human Factor in Industry

Friday, May 29, at 3 —The Human Factor in the Social Services.
At 8.15.—The Human Factor in Education

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SATURDAY, MAY 30, 1931

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No 3213, VOL 127]

Science and the Human Factor.

IN the present industrial depression there are many who regard rationalisation as on trial, and question the value of large industrial combinations It is suggested that such combinations are themselves partly responsible for the increase in the volume of unemployment, and that they tend to ignore the human factor While, however, it is freely admitted that rationalisation may and often does involve a temporary displacement of workers, the expansion in new directions which takes place as a direct result of more efficient management soon tends to absorb more than the number of workers displaced

The issue is partly obscured by the tendency in some quarters to confuse rationalisation with mere industrial amalgamation and cartels Scientific management is, however, a larger question even than rationalisation, in that it is of importance to industrial undertakings of every size, although, in theory at least, scientific management would itself initiate a policy of rationalisation if the facts in particular cases warranted it The importance of scientific management under modern industrial conditions is, however, undisputed, and valuable work is being done in this field both by the International Management Institute and by the Institute of Industrial Administration

Labour has now come to realise, to some extent, not only that science is much more than mechanical invention, and that scientific research is continually responsible for creating new industries and fresh employment, but also that under modern conditions the application of scientific methods of thought to the control of industry is of the utmost importance In spite of the fact, however, that applied science has eliminated from certain of our industries some of the grosser forms of labour which were formerly accepted as a matter of course, and that, contrary to prediction, hours of work have been decreased and not increased, the essentially humanising influence of scientific thought and method in industry is still far from being appreciated It is noteworthy, therefore, that in the scientific studies of management problems which are being carried out by the International Management Institute, the main object is to safeguard the human factor and, instead of viewing man as a piece of mechanism, as in Taylor's system, to adapt the machine to the man The selected subjects for research have included, for example, welfare devices, the selection and training of workers, and accident prevention Efficient business management to-day

and any true rationalisation policy are invariably characterised by a careful study of the human factors, which are, indeed, regarded as of supreme importance It is now widely realised that industrial efficiency cannot be attained unless the conditions of work are such as to secure the health and intelligent interest and co-operation of the workers to the maximum extent

The part played by science in securing improved and safer conditions of labour is often overlooked, but the work of the Industrial Health Research Board alone would demonstrate the importance of scientific research in this field Industrial physiology, of course, is only one section of the field of scientific management, but it is the section in which the most important modern developments have occurred During recent years, the study of industrial physiology and psychology has elaborated methods of preventing strikes and of promoting co operation between the different organisations of production, which are to-day part of the scientific organisation of labour in America These researches have the same object as the strict application of Taylor s principles in factory and workshops The success of such work is demonstrated by the changed attitude of the workers, who recognise that attempts made to increase production have become more humane and devote more attention to the human side and the health of the operators

Much of the work of the Industrial Health Research Board is only preparatory, but conclusions have already been reached which involve no revolutionary changes and, indeed, only place on a scientific and statistical basis the empirical practices of progressive firms The value of such results is demonstrated by the fact that they have already been adopted in certain branches of industry, and more widespread acceptance would greatly increase their utility For example, the American Bedaux system, which has already been introduced by a number of important firms in Great Britain, essentially incorporates the rest-pause, the value of which has been so conclusively demonstrated by the work of the Board, and settles the wage of the operative on the basis of the work he does and the compensatory rest period which should follow

In spite of the complexity of the problem presented by industrial physiology, there is no reason to be dissatisfied with the rate of progress On the contrary, the Industrial Co-ordination Committee appointed by the British Association at Bristol last year has drawn up a programme for the centenary celebrations in September which is designed to facilitate and co-ordinate the contribution of science to industry and its management The programme includes five citizens' lectures and a series of meetings to discuss such subjects as research into management problems, the training of managers, physique, posture and environment in relation to work, and the contributions of science to economy and safety in transport

This work on industrial health and conditions of work has a definite relation to the movement towards industrial safety which received so large a stimulus from the Conferences of the International Labour Organisation in 1928 and 1929, and particularly from the Industrial Safety Convention adopted at the latter Conference Industrial health is not simply a matter of securing that adequate precautions are taken in the handling of toxic materials or of dangerous machinery Science can do much to eliminate such risks, and it is well known that the accident rate in works where explosive or highly toxic substances are handled under pressures of hundreds of atmospheres or at very high temperatures is frequently below the average in industry Indeed, for every case of poisoning by gases or fumes in the chemical industry, there are twenty-five accidents caused by falls or slips

Statistics reveal that ninety per cent of industrial accidents are due to failure of the human element Such failure may be manifested in two ways In the first place, it is frequently due to ignorance of the existing dangers or of the precautions required The cleaning and repair of containers, to which a session was devoted during the recent National Safety Week in Leeds, is a pertinent example While the precautions to be observed in the handling of containers used for the storage and transport of such organic solvents as carbon disulphide, ether, benzene, and naphtha are comparatively well known in chemical industry, largely owing to its relatively high percentage of scientific personnel, they are far from being adequately known in the large number of other industries in which such solvents are widely used The large number of trade or fancy names under which solvents are sold is an added danger and is frequently responsible for the omission of precautions Even in the chemical industry itself, while the toxic and fire risks are well known, the danger of fire or explosion from the generation and accumulation of static electric charges by the flow of such solvents through pipe lines, etc , is frequently overlooked One of the most important problems of industrial safety is the handling of the mass of vital information scattered through general scientific

literature and its presentation in a convenient form for use by those concerned

A disaster like that at the chemical works at Castleford a year ago is fully investigated, but as many lives may be lost in a sequence of accidents during a year owing to a repetition of avoidable circumstances, without adequate publicity or investigation Through lack of information as to the causes of such minor explosions or accidents, casualties may occur year after year in different countries before effective means of prevention are discovered The publication, abstracting, and indexing of safety information is a formidable problem and awaits an organised attack by scientific workers, before the results of their researches can become freely available for the development of adequate safety measures in industries that are not static but continually expanding and changing as a result of scientific research

Such important contributions of science cannot entirely eliminate the human factor in accidents Not only is some slight failure of the human element—momentary neglect or carelessness—responsible for ninety per cent of industrial accidents, but also accidents are always unduly prevalent among a comparatively small number of workers The evidence shows that absenteeism due to sickness is usually abnormally high among the same persons, and that on an average they are also less skilled at their work Generally it may be said that those who are most suited to their work or environment react the most healthily to their environment, whether we measure the reaction by working efficiency or skill, tendency to sickness, or proneness to accidents

It is thus evident that vocational selection is of outstanding importance as much from the point of view of industrial safety as from that of industrial efficiency No more valuable work is being done by the National Institute of Industrial Psychology than that which it is carrying out in this field, and as a result of the application of scientific methods remarkable progress has already been made In spite of the cramping influence of unemployment on the application of some of the newer methods of vocational selection and guidance which have been elaborated, it has been demonstrated that we can at any rate avoid placing in dangerous positions those peculiarly liable to accidents, and the policy of eliminating the unfit before and not as a sequence to accidents is not utopian A classification into risk classes according to personal characteristics has already been indicated as possible

During the last century, therefore, it may be said with confidence that the whole tendency of science has been towards the amelioration of conditions of work Grosser forms of labour have been eliminated or transformed Scientific measures of protection have been elaborated which have rendered innocuous industrial processes which would have seemed incredible a generation or two ago Scientific research in industrial physiology and psychology is continually improving conditions of work so that both the health and efficiency of the worker are improved, and is now being applied to ensure that, so far as possible, young persons entering industry are fitted into occupations for which they are temperamentally suited

Such progress has inevitably improved the relations between science and labour, and those relations would become more intimate if scientific workers addressed themselves more whole heartedly to the work of education Upon their efforts the increasing expansion and application of the investigations of the Industrial Health Research Board and of the National Institute of Industrial Psychology largely depend The success of industrial safety work depends fundamentally upon the co-operation and enthusiasm of the scientific and management staff in industry Nor can the human aspects of rationalisation and its insistence on co-operation be more effectively served and fully influence industrial developments than through the power which scientific workers can exert through their privileged position in industry and their devotion to that ideal of service to which the spirit of science is kin

The Problem of Butterfly Migration

The Migration of Butterflies By C B Williams (Biological Monographs and Manuals) Pp xi + 473 (Edinburgh and London Oliver and Boyd, 1930) 21*s* net

FOR many years naturalists have known that the author was collecting material for this work, and have looked forward with great interest to its appearance His own experiences have been prolonged and varied—gathered during considerable periods of residence in Trinidad, Egypt, and the north-eastern area of Tanganyika Territory He has thus been able to compare the phenomena of migration presented by different butterflies in different parts of the world, as well as those presented by the same species during successive seasons in the same area He has also diligently collected records of migration wherever they could be found The difficulty in tracing the numberless references

to the subject must have been immense, and an exhaustive treatment of the literature in any reasonable time, impossible, for, as the author points out, "owing to the way in which they strike the general public, records of large flights of butterflies appear to be particularly frequent in popular magazines, and it is recognised that many such accounts must have been missed" He therefore appeals to naturalists for help by sending references direct to him or by publishing the data in some convenient journal under a suitable title "Few things', he writes, "are more exasperating than to discover that one has overlooked an important record of butterfly migration which was described in a popular book, 'Through Malayan Mud in a Motor', or—still more unforgivable—in a serious entomological paper entitled, let us say, 'New Diptera Nematocera from Tasmania'!" It is to be hoped that these words will receive the attention they deserve, and that the author will be given all possible help in his important and interesting inquiry

The scope and general treatment of butterfly migration in this work may be inferred from the Contents, which show that, after a brief introduction, the volume is arranged in five parts I, A preliminary discussion giving a general outline of the subject, and, in a second chapter, describing flights in progress, II, migration treated according to species, the evidence being given in ten chapters, of which the last treats of migratory moths two chapters, vi and viii, are devoted respectively to *Danaida plexippus* and *Vanessa cardui*, the chief migrant butterflies, III, migrations considered geographically—a single chapter, in which certain special areas are treated, IV, general discussion in seven chapters, dealing respectively with the nature of migratory flight, the condition and behaviour of migrants, causes of the start, determination of route and goal, comparison with other animals, general problems, summary, conclusions, and future work Part V contains an admirably full bibliography, followed by four indices on general subjects, species, countries, and authorities quoted

It will be clear from the above abstract that the work is well arranged and comprehensive, and that any one of the vast number of records which are included can be easily found It is, in fact, a rich mine of information on a fascinating subject, and this leads to the only serious general criticism of the volume The author appears to have been so intent on the admirable plan of collecting and setting before us all the available data, that he rarely 'lets himself go' on the relatively few observations which seem to be especially illuminating Thus, on the interesting subject of "Butterflies resting on the Sea" (p 342), the observations of F Muir and J C Kershaw, although conducted upon moths, certainly throw more light on this aid to migration than any of those quoted These naturalists were on a voyage from Hong Kong to Ceram, and on Nov 29, 1908, were about 190 miles S S E of the Lower Cochin China coast and about 120 miles from the Great Natunas "About 10 A M", Mr Muir wrote, "we noticed many small moths settled over the deck and all in *perfect* condition, as if just hatched At first we suspected that they were bred in the ship, but soon discovered that they were coming on board in numbers They had the power of resting on the surface of the sea—even in the broken water around the bows of the boat—and then rising and continuing their journey" Sixteen small moths belonging to four species, and including one delicate 'Plume', were collected The naturalists believed that these had flown from "the Lower Cochin China coast, and, if no bad weather turned up, would reach the various islands, and even Borneo, in fair numbers" All four species had a wide range, unaccompanied by marked local variation, over tropical Asia and the islands to the south—facts to be reasonably explained by the power of distribution in the manner described above (*Proc Ent Soc Lond*, pp xxxviii-xl, 1909) The reference to these observations is to be found in the bibliography but, unfortunately, not under the names of the observers It may be added that comparatively heavy moths can also rise in flight after coming to rest on the surface of the sea, as observed by C L Collenette in the Gulf of Panama (*ibid*, 3, p 65, 1928) That the resting place is not without danger is shown by a Hawk moth taken from the stomach of a fish in Suva Harbour, Fiji, and presented to the Hope Collection by Lieut L H Mosse-Robinson

Again, the existence of a social stimulus leading butterflies of other species to join a migrating stream, a subject briefly alluded to on p 353, appears to be proved by another significant observation made by Mr Muir, who describes "the sweeping up of the non migrating butterflies on a Papuan island when a migratory flight from another island passed over it In this instance, in which more than a single species was involved, it is evident that the social stimulus, and this alone, availed to compel the non migrating butterflies to become migrants—with such success indeed that the island was comparatively depleted of these species after the migratory stream had passed" (*ibid*, 4, p 19, 1929) In this instance the bibliographical reference omits the

observer's name and also, unfortunately, gives no clue to his illuminating observations

In the important discussion (Chapter xvi) of the conditions determining the start of a migratory flight it would have been well to refer back to pp 96 and 97, where observations on the overcrowding of Pierine breeding-places are quoted—those of Robinson in India and Pitman in Uganda—or even better, to have quoted or transferred the relevant passages The words of the last-named naturalist might also with advantage have been added to the quotation on p 97—" It struck me at once that such a breeding area must most certainly be the source of some of the numerous Pierine migrations so frequently witnessed in this part of Africa " (*ibid*, 3, p 45, 1928) The suggestion of a perennial source is also supported by the fact that the butterflies sent home were shown by their small size to have been starved, and that similar dwarfed specimens had been received two years before from a migratory flight of the same species encountered far to the south of the great breeding-ground in the West Nile Province (the old Lado Enclave) so graphically described by Pitman (*ibid*, p 46) Referring to the overcrowding witnessed by Robinson and Pitman, the author writes on p 97 "There is little doubt that it is from such mass breeding areas that flights start, but apparently in both these cases conditions were not, or had not been, suitable for bringing about a migration If one such area could only be watched for a continued period we might learn much as to the origin of migration " Until such prolonged observations can be carried on, we shall rarely be offered the direct evidence of flight from an overcrowded area Occasionally, however, by a happy accident a naturalist has been present at the critical period Thus, Sir Guy Marshall has recorded that the migration of another Pierine butterfly (*Catopsilia florella*) was actually taking place from a Rhodesian valley where the conditions were those described by Robinson and Pitman (*ibid*, p xiv, 1921) Here, too, it would have been well if this brief but important record had been quoted and referred to in the bibliography under the name of the observer

A few points of systematic interest and a good many mistakes in the spelling of names, although but a very small proportion of those which appear, will require adjustment in a later edition Thus, *Danaida plexippus*, the great North American 'Monarch' which has spread to so many parts of the world, is treated on p 149 as if it were the same species as a much smaller Danaine, the Oriental *D genutia* Although the two butterflies are closely related and the latter represents the Old World ancestor of the former, there can be no doubt that they are *now* entirely distinct *Libythea*, which has unfortunately given its name to a sub-family (Libytheinæ) of the Erycinidæ, as shown on p 242, has now been removed from this family and placed among the Nymphalidæ The following mistakes in spelling were noted *limniacea* for *limniace* (36, 80), *camadera* for *camadeva* (40), *erithronius* for *erithonius* (49, 460), *Pinacopterix* for *Pinacopteryx* (99), *gidaca* for *gidica* (105), *aglaiœ* for *aglaia* (116), *napae* for *rapae* (125), *Synchlœ* for *Synchloe* (126), *Telechinia* for *Telchinia* (240), *andromycha* for *andromache* (240), *Cymathœ* for *Cymothoe* (285, and *œ* elsewhere), *Sarangesia* for *Sarangesa* (401), *berenica* for *berenice* (403), *vitelline* for *vitellina* (408) These collected errors will create an unfair impression unless it is remembered that they are very few as compared with the great number of names printed in the volume Nearly all the verified references were found to be correct, although "Carpenter " did not appear on page 137, given in the index Also, the reference on p 354 (l 8) to a publication in 1922 should have been given as 1921, correctly quoted in the bibliography

The preparation of this most valuable work has been an immense labour and its appearance will lead to rapid advance in our knowledge of the subject, leading to that noble fate which the late G H Verrall described in arresting words "The finest monograph is the one which will be soonest out of date!"

E B P

Robert Hooke

Early Science in Oxford By R T Gunther Vol 8 *The Cutler Lectures of Robert Hooke* Pp vii + xii + 391 + 18 plates (Oxford The Author, Magdalen College, 1931) 25s

ROBERT HOOKE was an Oxford man, for he was a servitor at Christchurch, and an assistant to Boyle there, before he came to London to work for the newly founded Royal Society Hence the appropriateness of this volume, which might otherwise escape us, for Hooke, living all the best known period of his life at Gresham College, as Gresham professor, and as Curator of Experiments to the Royal Society, as surveyor of the City of London and architect of some of its buildings, even as a Westminster boy, seems essentially a Londoner

The Cutler Lectures, which were founded to give Hooke "wherewith to scolay ", offered an occasion for him to publish his many sided ideas As

Dr Gunther says, the volume in which they are collected has now become exceedingly rare Hence he has reproduced the whole in facsimile, or nearly in facsimile, for, though every page and diagram has been photographed, there is almost as wide a difference in flavour between this book and the original of it as there would be between the original Robert Hooke and a modern waxwork image of him Still, we have Hooke's words, and they deserve some attention, for he was a very remarkable man, and has passed into the history of science as a jealous and querulous claimant for originating discoveries that other people perfected

It is quite possible that Hooke was a difficult man in his personal relations, but there is nothing in this volume to justify the reputation that has clung to his memory so persistently His mind was one of extraordinary fertility, and there seems to have been no branch in the seething physical discoveries of the second half of the seventeenth century in which he did not mingle, and to which he did not contribute Hence he usually found himself in competition with others, but even in the controversy with Hevelius on the advantage of using optical aids to enhance the value of the divisions of an astronomical instrument, he was not only right, but also appears to have written no word that was less than civil or that one would wish to withdraw Nor, in saying so, need we allow for the somewhat ferocious manners his times permitted Everyone knows that he was inventive and industrious, but not everyone that he wrote as a man of careful, judicious type, who knew exactly where theory ended and what could be done with the practical resources then at command

Hooke's misfortune was that he covered the whole field of scientific curiosity, and that in every branch of it there were better, if more limited, men than he He was a good astronomer, but Hevelius and even Flamsteed were better He appears to have been a beautiful mechanic, with a fine sense of design, but the brothers Constantine and Christian Huygens were even finer He was a distinguished architect, but not to be mentioned with Wren Finally, he had a penetrating insight into physical theory, only to be utterly outclassed by Newton

'Hooke's Law' for the restitutive force of springs, with its application to the production of synchronous watch balances, and the bending moment for beams, we find here Though many of the other matters are controversial, and need not now concern us, possibly the most remarkable of his anticipations is that contained in the first of these lectures It is largely unknown, because its outcome was negative It is a search for stellar parallax, as a practical verification of the Copernican theory, such as afterwards led Bradley to the discovery of aberration, and it is conducted on exactly the same star, γ Draconis, and by exactly the same method, a fixed vertical telescope It was carried out with all the thoroughness and forethought and skilful design that would have ensured success, had it been anywhere within reach

R A S

Surveying Methods

(1) *Applied Aerial Photography* By Capt Ashley C McKinley With a Chapter on Oblique Aerial Surveys (Canada), by A M Narraway Pp xiv + 341 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1929) 25*s* net

(2) *La topographie sans topographes traité de photogrammetrie* Par F Ollivier Pp xviii + 301 (Paris Éditions de la *Revue d'Optique theorique et instrumentale*, 1929) 42 francs

(3) *Mesure optique des distances et methode des coordonnées polaires avec etude spéciale du tachéomètre auto reducteur Bosshardt Zeiss* Par Rodolphe Bosshardt Traduit par Prof Maurice Delessert Pp 172 (Geneve Georg et Cie, 1930) n p

(1) THE title of the first of these books is ill-chosen The subject is the technique of air photography for topographical purposes There are brief excursions into map reading and plotting, but they, like the bibliography, are but notes by an amateur for amateurs On the other hand, the technique of flying, photographing, developing, indexing, 'mosaicing', and the like, shows the hand of an experienced and practical man Mr McKinley knows his own subject He is an enthusiast, for he thinks that the "*exclusive* use of ground surveying will become obsolete" On the other hand, he realises that "no one factor has retarded advancement so much as the assertion of exaggerated claims" He writes for an American audience, describes American aircraft and cameras, and uses such words as "restitution" (of air photographs) and such expressions as "dividing the polyconic projection into rectangles". Enough has been said to show that Mr McKinley's book will be a useful one for pilots and photographers, but of small value to the surveyor who has to apply these photographs to his map-making

A final chapter by Mr Narraway, Dominion Land Surveyor of Canada and Aerial Surveys Engineer,

describes the perspective grid (oblique photograph, small scale) mapping method, originally suggested by the late Dr Deville and used with such success in the mapping of the Laurentian Plateau

(2) Commandant Ollivier deserves our thanks He deals with ground photo surveying—from Laussedat and Deville to Van Orel, and from photogrammetry to the stereoautograph—and he promises another volume to deal with air photo survey History, instruments, precision, errors, methods, processes, and results are all as clear and logical as one expects from the best French books It is perhaps not very important that the author's lack of interest in foreign methods and personalities is equally French

This is, for its compass, the clearest guide to the subject which has appeared It is all to the good, too, that Commandant Ollivier is an enthusiast The comparisons with ground methods are, however, exactly on a parallel with those of Deville Neither the one nor the other knows how small scale topography should really be done But that is not the point Anyone who wants the theory and practice of photo surveying can get it from this book, and will be very interested , but let him remember two points which are not brought out First, you cannot survey if you cannot see, and therefore you cannot use photo surveying in a forest or in a flat country of hedgerow timber , and secondly, photographic methods are essentially medium scale They offer little, if any, advantage to the property surveyor or the small scale topographer

(3) Here we have a Swiss book on a third, equally important, aspect of surveying, that of optical methods of measuring distance—methods which lend themselves obviously to a subsequent plotting by polar co-ordinates British surveyors of the past were content to class tachymetry as a method giving, roughly, errors of the order of one part in five hundred Modern telemeters (for which the base, or graduated staff, is held horizontally, thus escaping the troubles of unequal refraction) have greatly increased its possibilities Were Great Britain faced with original property surveying at the present time, there is no doubt that optical measures would be given their chance, and engineers and other large scale surveyors will do well to explore their possibilities

Mr Bosshardt's book is well designed, clear, and definite in its analysis of errors and description of instruments, and those who read French with greater facility than German will find excellent reading in Prof Delessert's translation

Our Bookshelf.

A List of Official Chemical Appointments compiled by direction of the Council of the Institute of Chemistry and under the supervision of the Publications Committee Seventh edition, revised and enlarged Pp 402 (London Institute of Chemistry, 1931) n p

"OFFICIAL Chemical Appointments ", now in its seventh edition, has firmly established its right to a place on the most accessible shelf of the chemist's library Moreover, since it catalogues the personnel of professional chemical services in connexion with State and municipal administration, it is consulted with increasing frequency by official, educational, and commercial authorities The new edition of some 400 pages, compiled under the auspices of the Institute of Chemistry, is divided into four parts The first gives information concerning the activities of official establishments employing chemists in the British Isles, with a list of holders of the appointments (with degrees and universities) In this section are found, for example the universities and schools, Government departments, water boards, industrial research associations, the National Physical Laboratory, public analysts, etc , and similar appointments in Northern Ireland and the Irish Free State In the second part, appointments in the Empire overseas are recorded

The third portion deals with societies and institutions, briefly referring to their objects, regulations for admission, etc , as well as mentioning the names of their officers The fourth section contains a list of acts of Parliament, orders, regulations, etc , affecting official chemical appointments, and is followed by indexes of names and places, unfortunately marred by long errata lists arising from the printer's oversight Subsidiary to its real utility as a book of reference are the pleasure which one may find in a study of the movements of one's former colleagues and acquaintances and the interest to be derived from the unexpected association of names with places

God and the Universe Eddington, Jeans, Huxley and Einstein By Chapman Cohen With a Reply by Prof A S Eddington (Issued by the Secular Society, Ltd) Pp 133 (London The Pioneer Press, n d) Paper, 2s , cloth, 3s

THE issues raised in this book are too important to be discussed casually in a few lines The relation between religion and science is, of course, a very old problem But the amazing developments of physical theories are apt to give a new setting to it When scientific workers find themselves in a philosophical mood, they indulge in offering their readers some tentative suggestions about the theological extension of their particular science So we get Eddington's scientific approach to religion, Huxley's religion without God, Jeans's mathematical God, and perhaps Einstein's Spinozistic God Philosophers should be thankful to men of science for such indications , the more so as they are not forced upon one by their authors with the same mental pressure often displayed by

metaphysicists Because scientific workers do not present their conclusions in this respect as binding and final, philosophers must return the courtesy and treat them, for example, in the same dignified spirit as that shown in Sir Arthur Eddington's reply to Mr Cohen's criticisms His case would have been perhaps stronger if Mr Cohen had shown more modesty and less partisanship in his statements and in his professional defence of materialism and free thought But when he starts off by proclaiming that after his criticisms of " very many " books by scientific workers aiming at reconciliation of science and religion, their authors decided generally that " discretion was the better part " and that " silence in their case spelt safety ", one may pertinently wonder whether Mr Cohen should be taken as a safe guide in philosophy, and whether he is qualified to pay compliments to that section of the Christian clergy whom he denounces as " dishonest " for acclaiming these men of science as being witnesses on behalf of God T G

Acoustics of Buildings including Acoustics of Auditoriums and Soundproofing of Rooms By Prof F R Watson Second edition, revised Pp x + 155 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1930) 15*s* net

It is not a great many years ago since the satisfaction of acoustical requirements was purely a matter of empiricism Here and there a scientific worker such as Rayleigh could explain the underlying principles , but seldom could an acoustic triumph, like the Free Trade Hall, Manchester, be acclaimed, nor could dependent data be obtained even from that , consequently, neither analysis nor synthesis came to our aid and architects were but blind leaders of the blind Wallace Sabine, however, introduced a new era into acoustical research, and now it is by no means uncommon to secure success Prof Floyd Watson's treatise is a welcome contribution to the synthetic treatment of the subject Whether it is better to secure original acoustic satisfaction or to correct acoustic failures, admits of no argument In either case, the author's work has the merit of showing the way The value of wires and sounding boards is almost entirely discounted in the light of modern investigation The concluding argument is interesting, in its recommendation that Sabine's advice (remembering the varying size of the audiences) to effect a compromise, is the desirable procedure For practical purposes the use of the different sound absorbing coefficients is of the greatest value

P L M

The Annual Register a Review of Public Events at Home and Abroad for the Year 1930 Edited by Dr M Epstein (New Series, Vol 172) Pp xii + 313 + 176 (London, New York and Toronto Longmans, Green and Co , Ltd , 1931) 30*s* net

The new issue of this useful book follows the usual plan of arrangement, which, combined with a detailed index, make reference easy The bulk of the volume records the political and social history of Great Britain, the Empire, and other countries The summaries are both full and readable, and omit no matter of importance in any part of the world The second part is devoted mainly to retrospects of literature, science, art, law, and finance during the year

Science has ten pages for its share, divided between the biological sciences, including anthropology, and the physical sciences Much interesting matter and many broad views are crowded into these pages, and some of the more important books of the year are mentioned The public document printed in full this year is M Briand's memorandum on the organisation of a regime of European Federal Union, with the report by the French Government on the inquiry The volume concludes with biographical notes of eminent persons who died during the year

Number the Language of Science By Prof Tobias Dantzig Pp xi + 260 + 11 plates (London George Allen and Unwin, Ltd , 1930) 10*s* net

The author of this interesting book has achieved a difficult task with much distinction, in showing that number, which is considered as the ' driest ' topic on earth, could be made the basis of a profoundly human story From the use of finger-prints to the invention of transfinite numbers, we are told how the theory of numbers, born in religious mysticism, has passed through a period of erratic puzzle solving before it acquired the status of a science Yet the book is not a technical history of the subject , so that it should interest not only mathematicians but also the wider circle of those who like to ask themselves how science has come about Symbols are scarcely used , but the historical method has been freely introduced to bring out the rôle intuition has played in the evolution of mathematical concepts This novel and pleasant presentation of an intricate subject is a great credit to its author T G

L'Art nègre à l'Exposition du Palais des Beaux-arts du 15 novembre au 31 décembre 1930 Par J Maes et Dr H Lavachery Pp 32 + 48 planches (Paris Les Éditions G Van Oest, 1930) 30 francs

This book, primarily a guide to the section of Negro art in an exhibition held at Brussels at the end of 1930, consists of two brief but adequate essays on the main characteristics of African art M Maes deals with the sculptural art of the Belgian Congo, and Dr Lavachery with that of the remainder of Africa a not unfair division of labour in view of the importance of the Congo as an art centre It will be remembered that from here came the wooden statuettes which have had such a marked effect in modern European art and æsthetics The plates figure a large number of examples Excellent as is the text within its limits, the plates alone make this something more than a mere guide-book and worthy of permanent preservation

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Atomic Weight of Cæsium · Use of the Word 'Mass-spectrograph'

THE first mass spectra obtained from cæsium by means of a hot anode showed only one line of mass number 133 As I pointed out,[1] the conditions of the experiment precluded any accuracy of measurement sufficient to decide whether the chemical atomic weight then and since accepted, 132 81, did or did not represent the weight of the atom Quite recently, K T Bainbridge,[2] using Dempster's method of analysis, has confirmed the simplicity of cæsium to such a degree as to make him confident that no other isotope exists to the extent of 0 3 per cent As he points out, on this view the atomic weight of 132 81 would imply a packing fraction of − 14 3 Such a figure would be so completely abnormal that it seemed desirable that it should be tested by direct and trust worthy means

The obvious method is to photograph Cs 133 be tween Xe 132 and 134 To be really convincing, the lines must be produced during the same exposure, and as the alkali metals and the inert gases are, from the point of view of mass ray technique, the extreme and mutually exclusive types of element, this is by no means easy After many trials, I have now succeeded in making a form of discharge tube capable of pro ducing the anode rays of cæsium at the same time as the gas rays of xenon Furthermore, by varying the quantity of the latter element present and the times of exposure, mass spectra have been obtained which enable the masses to be compared with an accuracy of 1 in 10,000 The results are conclusively against any abnormality If we assume the packing fraction of xenon to be − 5 3 ± 2 0, as already determined, that of cæsium is − 5 0 ± 2 0, the weight of the cæsium atom ($O^{16} = 16$) is 132 933, and using Naudé's factor of 1 25 in 10,000 to transform to the chemical scale we get

At Wt of Cæsium = 132 91 ± 0 02

In further reference to Bainbridge's letter, I should like to lodge an objection to his application of the word 'mass spectrograph' to Dempster's form of analysis This word I coined in 1920 to describe an instrument which by its peculiar sequence of electric and magnetic fields eliminated the effect of varying velocity and gave a spectrum dependent upon mass alone Dempster's apparatus, described two years earlier, is essentially an application to the analysis of positive rays of the well known and widely used principle of semicircular magnetic focusing Such an instrument gives a magnetic spectrum which depends upon momentum and not upon mass *per se* The fact that it is the standard method for determining the energies of beta particles makes this sufficiently obvious The use of the word mass spectrograph, unqualified in any way, to an apparatus not using in any manner the principle implied in it, appears to me to be a misleading and undesirable practice

F W ASTON

Cavendish Laboratory, Cambridge,
May 16

[1] *Phil Mag*, 42, p 440, 1921
[2] *Phys Rev*, 36, p. 1668, 1930

Petroleum and Alpha Radiation.

IN NATURE of Feb 28 (127, p 317) reference was made to my recent address before the American Association for the Advancement of Science,[1] as reported by Science Service Lest the 'novelty' of the possible rôle of alpha radiation in the interaction of hydrocarbons in the earth's crust obscure its true relative importance, I should like to make a further communication and to suggest a new way of accounting for the absence of free hydrogen in natural gases

In the first paper of Lind and Bardwell on the action of alpha particles on saturated hydrocarbons,[2] it was pointed out that similar reactions *must* take place in the earth's crust if conditions exist where alpha particles bombard hydrocarbons While these conclusions were then based on experiments with gaseous hydrocarbons, there was indirect evidence that the reactions extend also to the liquid members More recent work by W T Richards[3] in the laboratory of Sir Ernest Rutherford gave direct proof that this is true not only for liquid but also for solid paraffins and that hydrogen is the principal gaseous product Calculations from Richard's results[4] showed that even the quantitative yield of hydrogen per ion pair is certainly not less than half of that in the gases

Hydrogen is therefore the most abundant gas produced by the reaction, and since Lind and Bardwell had shown[5] that it does not interact further with unsaturated hydrocarbons under alpha radiation, it becomes an important criterion of reaction unless it is removed in some other way

The fact, however, that free hydrogen is conspicuously absent in natural gases (except in some volcanic regions) led us to conclude that the problem of its disposal must be met before even a partial radioactive origin of petroleum could be accepted Under catalytic conditions which are quite possible, hydrogen could recombine with liquid unsaturates, but this would account for less than half of it, assuming the initial hydrocarbons to have been saturated, since all the hydrogen liberated in condensation to higher saturates would still remain free

If, however, the original hydrocarbon (or hydrocarbons) be assumed to have been unsaturated (or if unsaturates have been produced from saturates by the thermal elimination of the necessary amount of methane), the complete catalytic removal of hydrogen under high pressure and high temperature conditions becomes possible, because the amount of hydrogen liberated by alpha rays is much smaller from the unsaturates—far less than the amount required for saturation Moreover, we do find petroleum to contain unsaturated members, possibly indicating an initial excess of unsaturation

Although this suggestion as to disposal of the hydrogen may be regarded as making the radioactive origin of part of our petroleum more probable, the abundance of methane in natural gases associated with petroleum seems to indicate that the *thermal* interaction of hydrocarbons at high pressures and temperatures suggested by Prof H A Wilson[6] is perhaps the more prolific source of petroleum, since, according to his theory, *methane* would be the lower terminal member

The recent note on this subject in NATURE also raised the pertinent question " is radioactivity a potential function in the type of environment and at the comparatively shallow depth in the crust which modern views seem now to imply for the birth of the oil globule ? " It scarcely appears possible to answer this question definitely, but certainly we would not be justified in a negative answer The distribution of a low radium content in the earth's crust is so general and so constant that its action extended over

The state of polarisation of the Raman lines has also been studied with the gases carbon dioxide and acetylene It is found that the strongest lines ascribable to a linear vibration of the molecule are nearly completely polarised The 'wings' appearing on either side of the exciting mercury lines, which represent the rotational Raman spectrum, are, however practically unpolarised, as is to be expected from the theoretical work of Manneback [5]

S BHAGAVANTAM

210 Bow Bazar Street, Calcutta,
April 18

[1] *Zeit f Phys*, **64** 173, 1930
[2] *Phys Rev* **34**, 582 1929
[3] *Proc Roy Soc*, A, **128**, 294 1930
[4] *Trans Roy Soc Canada* **24** 197, 1930
[5] NATURE, **125**, 88, 1930

Forestry Research in Great Britain

I SHOULD like to support the plea put forward in the recent article on forestry research in Great Britain (NATURE, May 16 p 729) that the Forestry Commissioners should in future take greater cognisance of research on the basal problems of pure science that underlie successful afforestation As chairman of the Research Committee of the British Association which has been the means of providing Dr M C Rayner with a small measure of assistance for her researches on tree mycorrhiza, I have been brought into intimate contact with one of the fundamental problems that concerns the establishment of forests on land hitherto devoid of trees I have been greatly impressed with the urgent need for more adequate facilities for this work than can be provided by the very limited funds of the British Association, and I venture to express the hope that the Forestry Commissioners will give sympathetic consideration to the desirability of assisting these investigations

F T BROOKS

Botany School, Cambridge,
May 18

The Form of Fæcal Pellets and Specific Identification

IN the differentiation of closely allied species, any additional character which may help to separate them will be of value In the case of ascidians, for example,

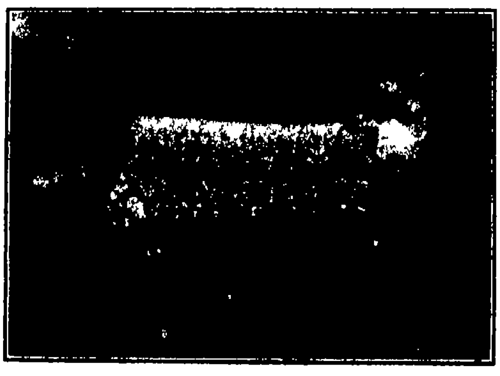

FIG 1 —Fæcal pellet of *Gibbula magus*

much help is obtained from the nature of the eggs A character, however, which has not previously been made use of is the nature of the fæces While in many cases these are either shapeless or else of very variable shape, a large number of animals have fæces of a quite distinctive type The specific character of the fæcal pellets may lie either in differences of their general shape or else in details of surface sculpture, the latter often being exceedingly elaborate, as in the example shown in Fig 1

While we have as yet investigated the fæces of only a limited number of species, the following examples of some of the animals which may be thus differentiated is suggestive of the value of the method *Nucula nitida*, *N nucleus*, *N sulcata*, *N tenuis*, *Syndosmya alba*, *S nitida*, *Gibbula cineraria*, *G magus*, *Calliostoma zizyphinus*, *Cantharides clelandi*, *Acmæa virginea*, *A testudinalis*, *Ascidea venosa*, *Ascidiella scabra*

We hope to give an account of some of these fæcal pellets in the near future, but meanwhile we suggest the value of examination of fæces, to those requiring additional characters for the definition of species

HILARY B MOORE

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Flint Implements of Lower Palæolithic Types from Northern Ireland

DURING a recent visit to Northern Ireland, one of us (J P T B) found in gravel lying between two Boulder Clays exposed in the valley of the River Carey, and in glacial gravel in the Dun valley, in Co Antrim, a series of flint implements of Lower Palæolithic types Other examples of these specimens, easily distinguishable by their forms, condition, and flaking from later artefacts, as well as from naturally flaked stones, were also discovered in certain post glacial gravel spreads of these two rivers

The ancient implements referred to are derivatives in both series of deposits, and their true antiquity is, from a geological point of view, therefore, unknown An examination of the specimens, however, demonstrates that they comprise forms which at other sites, in East Anglia for example, are recognised to be of Early Pleistocene date As is known,[1] at this epoch, over very wide areas of the earth's surface,[2] the evidence is clear that ancient man was engaged in making coarsely flaked hand axes by means of a skilful development of the earlier rostro carinate implements It is, therefore, of considerable interest and importance to observe that these newly discovered specimens from Northern Ireland comprise coarsely flaked hand-axes of rostroid forms, and rostro carinates

The manner in which these implements were made in Ireland is precisely similar to that in which others were formed during the epoch of the Cromer Forest Bed of East Anglia, in Palestine, in South Africa, and in India In view of this significant fact, we feel justified in claiming that flint implements of Lower Palæolithic (Early Chellean) types have now been discovered in Northern Ireland, and we propose in the near future to publish a detailed account of this discovery It is well also to recall that, many years ago, the late Mr W J Knowles claimed to have found Palæolithic implements in the so called 25 ft raised-beach of Northern Ireland The majority of these specimens, of Palæolithic forms, one of us (J P T B) would, however, not accept as of this antiquity, though we consider it probable that a few of them are to be relegated to Palæolithic times

J REID MOIR
J P T BURCHELL

May 9

[1] *Jour Roy Anthrop Inst*, vol 41, 1921, and vol 55, 1925
[2] *Jour Roy Anthrop Inst*, vol 60, 1930

The Peking Skull *

By Prof G ELLIOT SMITH, F R S

WITH characteristic promptitude, Prof Davidson Black has now provided us with a full report upon the features of the Peking skull, giving a detailed description of its external form, illustrated by 16 photographic plates (each photograph provided with a transparent explanatory drawing) and 37 text figures The drawings represent exact orthogonal projections not only of the type skull but also of the second skull of *Sinanthropus*, the finding of which was discussed in NATURE of Aug 9, 1930 (p 210), and of a series of other fossil human skulls The purpose of this comparison is to define the distinctive characters of *Sinanthropus* and to emphasise the contrasts in size and proportions that differentiate it from *Pithecanthropus* and the series of Neanderthal skulls An elaborate series of measurements is provided, together with a statistical analysis of the significance of the figures, in comparison with those of other fossil human types, as well as of representatives of modern races of men Hence complete data are now available to enable the anthropologist to realise the distinctive features of the Peking skull and the reasons which induced Prof Davidson Black to differentiate it from all other known human types and assign it a distinctive generic rank

The history of the finding of the skull by Mr W C Pei on Dec 2, 1929, has already been told in NATURE (Mar 22, 1930, p 448) It was not until four months later that Dr Black completed the process of removing from the surface of the skull the hard mass of travertine in which it was embedded He then began to make casts and photographs of the specimen and to prepare the preliminary reports After this was accomplished, he set to work to expose the interior of the skull, and in this he was inspired by the motive of preserving if possible the natural endocranial cast Fortunately, this was possible because the braincase was fractured, enabling the bones to be removed piecemeal Moreover, the skull is that of a young adolescent, whose age, in Dr Black's opinion, corresponds to that of a modern child between the time of eruption of the second permanent molar teeth and the attainment of adolescence, say 15 ± 2 years Thus it was possible easily to disarticulate the constituent bones This work lasted until well into the summer of 1930, when Dr Black succeeded in removing the cranial bones from the surface of the endocranial cast and then reconstituted each individual bone, and eventually rearticulated the skull with more precision than it had at the time when it was found Before doing so, however, he made photographs and models of each separate bone, and took X ray photographs to display the sinuses and other details in the texture of the bones, such, for example, as the labyrinth in the temporal bone Then the skull was rearticulated and an artificial cast made of the cranial cavity

The present monograph describes the external surface of the skull and each individual bone The description of the endocranial cavity and cast which Prof Davidson Black has obtained of it will be discussed in a second monograph that is now in course of preparation

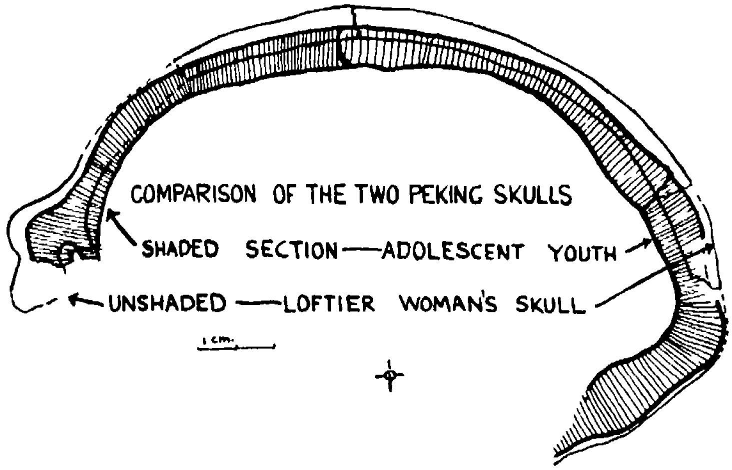

FIG 1 —Median longitudinal projections of the Peking skulls × ½

In July 1930 a large part of a second braincase was obtained from certain blocks of limestone which had been brought into the laboratory in October 1930 In his monograph Dr Black gives full details of the comparison of the two skulls and the evidence upon which he relied to interpret the sexual characters and ages of the two individuals The skull obtained in December 1929 he now regards (for reasons set forth in full in this report) as that of a youth in a stage of development between puberty and adolescence, and the second skull that of a woman Partial obliteration of the left side of the coronal suture suggests that the latter was an adult, possibly more than ten years older than her companion In the accompanying diagram (Fig 1) Prof Davidson Black's drawings of median longitudinal projections of the young skull (shaded) and of the adult (female) skull have been superimposed The female skull is slightly thinner than that of the youth and is also larger, being somewhat higher and longer than the male skull (Fig 1) and presenting other differences which are probably expressions of the difference in sex

In view of the claims put forward by certain writers that the Peking skull should be included in the genus *Pithecanthropus* or, alternately, in the species *H neanderthalensis*, Prof Black has devoted a large amount of attention to the comparison of

* Davidson Black, On an Adolescent Skull of *Sinanthropus Pekinensis* in Comparison with an Adult Skull of the same Species and with other Hominid Skulls, Recent and Fossil', *Palæontologia Sinica*, Series D, vol 7, Fascicle 2 (Peiping Geological Survey of China, Peiping, April 28, 1931)

the projections of the skulls of *Pithecanthropus* and the various representatives of the Neanderthal species By means of statistical comparisons he has made out a conclusive case in justification of the necessity of making a new genus and species for the reception of the Peking skulls

While it is evident that the crania of *Sinanthropus* and *Pithecanthropus* resemble one another (Fig 2) much more closely than they do any other human type, it is no less certain that they differ from one another in point of size, proportions and detail to a degree amply sufficient to proclaim their generic distinction It is a remarkable fact, Prof Black adds, that in all its cranial parts *Pithecanthropus* shows ' evidence of an archaic specialisation in marked contrast to the evidences of archaic generalisation so abundantly preserved in the crania and teeth of *Sinanthropus* " In other words, the apparent primitiveness of the Java fossil is in part probably due to degenerative changes responsible for the uncouth shape of the skull, which presents so striking a contrast to the elegant and undistorted braincase of the Peking man Apart from its massive supraorbital torus and reduced third molar tooth, the Peking skull presents no highly specialised features On the contrary, its general proportions, the morphology of the teeth, and the features of the tympanic and other individual elements of the skull, all provide evidence that *Sinanthropus* was a generalised and progressive type

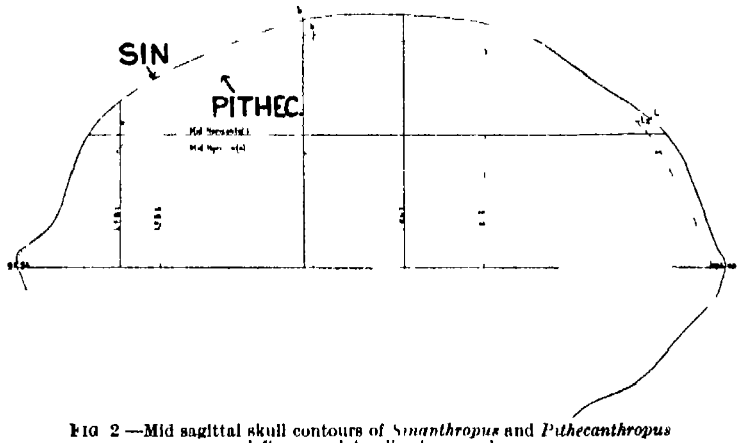

FIG 2 —Mid sagittal skull contours of *Sinanthropus* and *Pithecanthropus* left norma lateralis view ½

Prof Black does not devote much attention to the comparison with the Piltdown skull The purpose of the present work is to provide anthropologists with a detailed description of his specimen and an exact comparison with other specimens of unquestioned and generally recognised authenticity For this reason, as well as to avoid partiality, he uses the data collected by Dr H Weinert in the case of *Pithecanthropus*, based upon the study of the actual fossil, with information provided by Prof Dubois in amplification Similarly, for the Neanderthal skulls Dr Black relies on the data and figures provided by Dr G M Morant As, unfortunately, there is still considerable doubt in the minds of many anthropologists concerning the Piltdown skull and the mode of its reconstruction, Dr Black does not make much use of it for comparison He does, however, emphasise the fact that the peculiarly developed postero-inferior parietal boss in the Peking skull resembles in certain important features the similar, if less obtrusive, development of the Piltdown parietal He also directs attention to the similar thickness of the skull in the genera *Sinanthropus* and *Eoanthropus*, but points out that the range of unevenness in thickness of the Peking skull presents a marked contrast to the more uniform Piltdown fragments

Although Dr Black himself has refrained from instituting detailed comparisons with the Piltdown skull, it is interesting to compare (Fig 3) the transverse section he provides of the skull of *Sinanthropus* (the thick lines) with a section made in the corresponding plane (auditory meatus) of the reconstruction of the Piltdown skull (the larger shaded area) made by the late Prof John Hunter This section, like the view of the two skulls from the posterior aspect, brings out the essential identity of their architectural plan in a most striking way, and reveals a similarity of form and proportions which is unexpectedly close Apart from the difference in thickness, the adult skull of *Sinanthropus* approaches even nearer to the Piltdown skull in some respects Thus (see Fig 1) it is loftier than the type skull and its height is identical with that of *Eoanthropus* but the latter is considerably wider and correspondingly more capacious

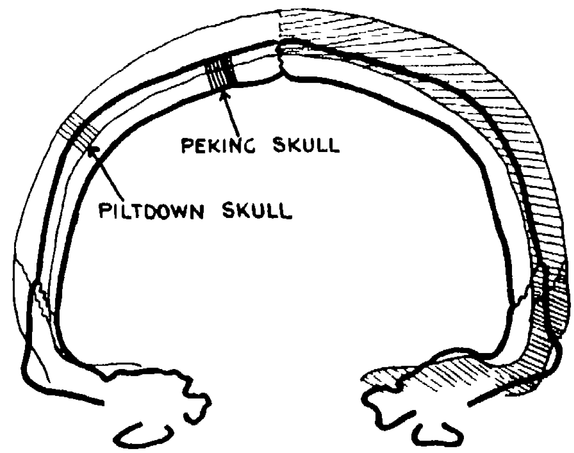

FIG 3 Transverse sections of Peking and Piltdown skulls × ½

The general form and proportions of the Peking skull, as well as the details of many of its constituent parts, are surprisingly modern in character The man of China was clearly a very primitive and generalised member of the human family close to the main line of descent of *Homo sapiens*

Prof Black devotes particular attention to the unique character of the temporal bone, which presents a marked contrast to that of all other known men and apes Of special interest are the distinctive features of the tympanic and mastoid portions,

showing, not only in the case of the mastoid but also in the form of the auditory meatus and middle ear, characters which in modern man occur only in new-born infants and very young children—a widely open meatus terminating at an ear drum the inclination of which closely approaches the horizontal This state of affairs is lost in *Homo sapiens* long before the age of puberty is attained As Dr Black remarks, the features of the tympanic region of *Sinanthropus* are admirably suited to serve as a starting-point for phylogenetic speculation "With this generalised type before us it is not difficult to imagine developmental stages through which such an element in a stem-form may well have passed, leading to the modifications such as are characteristic of the Piltdown, Neanderthal, and modern men" On the other hand, since all the essentials of the tympanic morphology of the great anthropoid apes may be recognised in these elements of *Sinanthropus*, a comparison of the latter may serve to indicate in some measure the degree of their divergence from a common type In spite of this provocative comment, Prof Davidson Black refrains from discussing the intriguing problems he mentions He does not depart from the admirable restraint that characterises all he has written upon this subject, which makes his monograph a reliable guide to those who want the data and prefer to form their own opinions as to their meaning

The great importance of the discoveries in China lies in the fact, not only that the material is more abundant than the remains found at Trinil and Piltdown, and their geological age is unquestionable, but also that, while *Sinanthropus* is differentiated from the genera *Pithecanthropus* and *Eoanthropus*, it is much more generalised than either, yet definitely linked to both While it is the most primitive type of human being so far discovered, its structural affinities with both the Javanese and the British genera link together all the known types of Pleistocene men and give cohesion to our knowledge

It is fortunate that the information concerning this unique material has been so fully and so promptly supplied to anthropologists in a monograph which is distinguished by admirable clearness and impartiality Once more Prof Davidson Black deserves our congratulations on a great achievement

The Spicer-Dufay Process of Natural Colour Kinematography.

By T THORNE BAKER

ALL modern attempts to reproduce by photography the natural colours of a subject depend upon some method of three colour analysis The theory that by the admixture, in various proportions, of blue-violet, green, and orange, any colour in Nature can be imitated, has been adequately borne out by practical experiment So-called 'two-colour' processes must at the best be regarded as crude attempts to saddle each of two of the primaries with one half of the third

Methods of photography in which a glass support is coated with a mosaic or matrix of tiny coloured areas of the three primary colours, and then with a photographic emulsion, are well-known Such material is exposed through the coloured mosaic, so that the light rays are microscopically analysed before reaching the sensitive emulsion It is then developed, and after the black developed image has been dissolved away, the previously unexposed silver salts are exposed to light and themselves developed and blackened in turn This procedure gives a positive transparency image, and if it be viewed by transmitted light—that is, through the coloured matrix on which it lies—the original picture will be seen in its original colours To A and L Lumière belongs the credit of having first issued such a material (1907), it is still known as the Autochrome plate, and is still largely used

Motion picture photography based on the same fundamental idea has proved vastly more complicated The coloured mosaic necessarily absorbs a very high proportion of the incident light, and corresponding increase in exposure is required With the advent of 'talking pictures', the old speed of sixteen pictures per second in kinematography has been raised to twenty-four, and with the best shutter mechanism this means that no more than 1/40 second can be allowed for each individual exposure Hence quite apart from the immense improvement in large aperture lenses which has come about in recent years, it has been necessary to produce panchromatic emulsions of extremely high sensitivity

The films exhibited on May 20 at the conversazione of the Royal Society at Burlington House were procured on a new film which has been developed during the past four years in the research factory of Messrs Spicers, Ltd, at Sawston, Cambridgeshire The film base itself, which is made at Sawston, is of the acetate type, and is non-inflammable in the strictest sense By a combination of new plasticisers with a novel method of maturation, a film has been produced which retains its suppleness and whiteness indefinitely So rapid is the maturing that the base can be used for photographic purposes a few hours after it has been cast

The base is coated with a very thin layer of collodion containing a green dye of the necessary concentration to act as a primary green filter It is then passed through a rotary printing-press of special design which impresses upon it 375 parallel ink lines to the inch, with the same number of intervening clear spaces It is next passed over rollers through a bleaching bath, which decolorises the green dye where it is unprotected by the greasy lines of printing ink It then passes through an orange dye, when the bleached spaces become dyed the primary orange Finally, passage through a series of benzole tanks against revolving brushes removes the printing-ink, and a material is left

stained with alternate green and orange lines, 375 of each to the inch. A second, similar, procedure, with the greasy lines printed at right angles, provides the third primary, blue-violet, and in this way a mosaic of more than half a million blue violet, green, and orange rectangular areas is formed on the surface of the film base.

The colour mosaic is next coated with two protective layers, in order to prevent any desensitising effect of the matrix colours upon the sensitive emulsion. A panchromatic emulsion of very high speed is finally applied. The whole procedure is carried out on 1000-ft lengths of film 21 inches wide, which are slit up into fifteen 'cuts' of standard kinematograph width, 35 mm. A very simple protective device makes it possible to leave a colourless sound track, one-tenth of an inch wide, in each cut, so that the recording of sound with colour can be readily achieved.

Careful control of the coating of the first layer of green collodion has resulted in the production of a matrix of very uniform balance, which has been found indispensable in order that, in the subsequent dyeing processes, a correct balance of spectral distribution is maintained. It is interesting to note that the theoretical primaries have been largely departed from, and that the overlaps in the spectra of the blue, green, and orange regions greatly exceed those usually agreed upon amongst three colour workers. That this has been justified is shown by the extraordinary faithfulness of the colour rendering.

The negative film, after reversal and redevelopment, becomes converted, as already stated, into a positive picture, which can be immediately thrown upon the screen. Such an original or 'master' positive would be of little value were it not possible to make an unlimited number of copies. The copying of any form of geometrical pattern has hitherto involved the appearance in the print of diffraction patterns or moiré, and this has greatly militated against attempts at the commercial application of matrix processes.

Satisfactory duplication of the Spicer Dufay pictures has been effected by a comparatively simple expedient. The coloured original is passed through the gate of the printing machine, and an image of it is thrown by projection upon the copying film, which is synchronously moved forward. The lens has been so designed that it will focus critically the black silver image of the master copy upon the sensitive film of the copying material, while the coloured matrix, which is separated from the image by about 10μ, is slightly blurred or diffused. In this way very exact natural colour copies can be obtained, which are printed at the standard rate of 800 pictures a minute. The ease of duplication at once places the process on a practical basis, for which there will doubtless be many scientific uses, apart from popular entertainment.

Centenary of David Edward Hughes

To commemorate the centenary of the birth of David Edward Hughes, whom Sir Joseph Larmor, in 1900, described as 'one of the great scientific inventors of the age", an address on his life and work was given by Mr Sydney Evershed, on May 14, to the Institution of Electrical Engineers, a society of which Hughes was president in 1886.

Born in London on May 16, 1831, Hughes was the son of a Welsh bootmaker, who in 1838 emigrated to the United States and settled in Virginia. At the age of nineteen he was appointed professor of music in St Joseph's College, Bardstown, Kentucky, and while there gave lectures on natural philosophy. Like many others, he became interested in the rapidly spreading electric telegraphs and in 1854 made a practical type printing telegraph. Resigning his professorship, in 1857 he returned to Europe to exploit his invention.

In the course of the next twenty years, Hughes made a fortune and, taking up his residence in London, devoted himself to scientific research, the first fruits of which was the invention of the microphone. He retained all his life the title of professor and his American citizenship. In 1880 he was elected a fellow of the Royal Society, in 1885 he was awarded a Royal Medal, in 1891 he became a vice president of the Royal Institution, and in 1896, four years after Edison, was awarded the Albert Medal of the Royal Society of Arts. He died from influenza, at his house, 40 Langham Street, on Jan 22, 1900, and was buried in Highgate Cemetery. After his death his widow returned to the United States, where she died about ten years ago. She had given his note books to the British Museum, but much of his apparatus was left in a furniture store near the Tottenham Court Road, where it lay unheeded until 1922. Through the action of the late Mr Campbell Swinton, much of the apparatus was secured for the Science Museum, where it can be seen. Hughes left a fortune of some £470,000. Of this he bequeathed about £13,000 to the Institution of Electrical Engineers, the Royal Society, the Paris Academy of Sciences, and other bodies, but the greater part went to the Middlesex, London, King's College, and Charing Cross Hospitals.

Many of these facts were referred to by Mr Evershed in the course of his interesting address, the main part of which, however, was devoted to a consideration of the two outstanding achievements of Hughes's life, the invention in his early years of the synchronous type printing telegraph, and then, in later life, the discovery of the microphone. "In these his genius was at its height, and, to use an engineering metaphor, it is the peak values that count when we attempt to estimate genius."

In the middle of the last century, said Mr Evershed, electric telegraphy was undergoing rapid development. In England we were using Wheatstone's needle instruments, in America, Morse had produced his ink writer and efforts were being made to make instruments print messages in plain type

At the age of twenty one, and possibly a little earlier, Hughes invented a printing telegraph with features of great ingenuity, devising a method of synchronous working between a revolving arm at the sending end of the line and a revolving type wheel at the receiving end At the receiving end the message was printed on a paper ribbon by the action of an electromagnet in circuit with the line Only one impulse was needed to print a letter

Inventions which come from outside an industry often display originality of thought, and that was true of the Hughes printer But it was something more than original It was what all great inventions are, a complete and practical adaptation of means to an end It worked, and it worked well It deserved to succeed, and it did succeed It was so good that Hughes was not long in getting the invention into use in America, and in 1856 it was adopted by the American Telegraph Company In the land of his birth, however, he discovered he was not a prophet, and so went on to France, where his instrument was widely applied From France he proceeded to Italy, Russia, Turkey, Holland, and other countries, where his ideas were also fully appreciated

With the coming of the submarine cables, Hughes's instruments were installed at the London end of the Continental lines, not on account of the merit of the apparatus, but solely as a concession to foreign idiosyncrasies Yet it is one thing to make a successful invention and quite another to get paid for it Too often the inventor is left to pick up the crumbs from the rich man's table But that was not to be the fate of Hughes He saw to it that he was well paid, and when he returned to England in 1875, from which time onwards London became his home, he was well on the way to making a large fortune out of his printing telegraph

Hughes now entered on the second period of his life, and at the age of forty four, with ample means, he found leisure for the work he loved best, experimental research The opportunity for making a discovery was to come almost immediately

Hughes's first invention was connected with the telegraph his second was connected with the telephone Bell's telephone was exhibited at Philadelphia in 1876, and the world soon realised that the problem of the transmission and reproduction of articulate speech had been solved But the telephone was capable of serving another purpose It was an extremely sensitive detector of minute variation in the strength of electric currents, and so a valuable weapon of research Hughes was one of the first to use the telephone for research, and his experiments led him to the microphone In this direction he was working in an entirely new field with nothing but mother wit to guide him Hughes was no theorist, and by what mental process he stepped from one experiment to the next will never be known Sir Oliver Lodge has said that "Hughes thought with his hands" The truth is that Hughes was born to make experiments and to find his way in the dark

Hughes's experiments are referred to in his paper on "The Action of Sonorous Vibrations on Varying the Force of an Electric Current", read to the Royal Society on May 8, 1878 In this paper he says that, being aware of the effect of light on the electrical resistance of selenium, he had an idea that sound might possibly have a similar effect on electrical conductors Many of his experiments gave negative results, but sounds impinging on the bad contact between the ends of a broken wire were accompanied by sounds in the telephone, and this afforded the clue Carrying on his experiments with loosely touching nails, metallic powders, bits of carbon, and other very simple apparatus, he was in the end able to hear a fly ' walking with a peculiar tramp of his own", and to the simple form of contact, sensitive to sound, he gave the name of microphone'

As soon as Hughes had published his account of the microphone, there followed the usual crop of anticipations But when we have awarded whatever credit attaches to a sporadic disclosure of uncorrelated facts, the honour must go to the man who begins at the beginning and perseveres to the end, the man who feels his way from experiment to experiment, gathering the facts as he goes, and continuing his efforts until the full scope of the inquiry has been brought to light That was the way of Hughes, and when his experiments had disclosed the main body of facts relating to the action of sound on electrical contacts, he gave his knowledge freely to the world

The next thing which engaged Hughes's attention was the induction balance, an ingenious instrument which excited much interest but, contrary to expectation, proved to have a very limited field of utility as a measuring instrument But it led Hughes to other experiments which made him acquainted with strange and bewildering phenomena From the note books preserved in the British Museum, which make interesting but difficult reading, Mr Evershed was able to throw much light on Hughes's experiments on transmitting signals over a considerable distance without conducting wires, which were once witnessed by Spottiswoode, Huxley, Stokes, and others In these experiments, the breaking of the circuit of the primary coil was done under conditions which, as we now know, must have resulted in high frequency oscillations Hughes did not know this, and he was not aware that his extra current was oscillating and that his primary circuit was radiating energy in the form of electromagnetic waves

Hughes, like others, was working at the fringe of a vast field for discovery—the wireless field And even after Clerk Maxwell, in his electromagnetic theory of light, had forged the key to the gate, a good many years went by before Hertz, who knew about Maxwell's theory, took the key and began the work of exploration that led to wireless communication Unfortunately, Hughes was not in possession of the key

In the conclusion of his tribute to Hughes, Mr Evershed remarked "Friendly speech brings

men together as nothing else can, and Graham Bell and David Hughes who gave us the telephone and the microphone deserve to be honoured every day of our lives It would be too much to suggest that you should think of these benefactors of mankind whenever you use the telephone, but the next time you are rung up for some far-distant friend, and hear his well-known voice speaking to you when you lift the telephone to your ear—give a passing thought to Graham Bell And then, when you speak into the mouthpiece of the transmitter—knowing that the microphone inside it will respond and that the current ripples which faithfully represent your voice will be carried far away to your friend—remember what you owe to David Hughes"

Obituary.

The Ven Dr J M Wilson

James Maurice Wilson was born in 1836, was senior wrangler in 1859, an assistant master at Rugby from 1860 to 1879 headmaster of Clifton College from 1879 to 1890, vicar of Rochdale and archdeacon of Manchester from 1890 to 1905, canon of Worcester from 1905 to 1926 The last five years of his life he spent in quiet but not idle retirement near Petersfield, Hants, where he died on April 15

This bare statement does not seem to suggest many opportunities for adventure, yet it was adventure in the very best sense that was the breath of his nostrils It was typical of Wilson that in extreme old age, when death was beckoning to him, he told one nearest to him that, though he did not know what happens to us after death, he was very keen to find out Yes, he was always very keen to find out the truth, and always brave to face it with all its consequences It was not his wont to abide comfortably in the old ways along which habit leads most men to slothful acquiescence Throughout his long life, in action and in thought, he was continually breaking with his past, and gloriously happy in the difficulties that the new work and the new problems presented The changes must have often seemed rash to the onlookers How the wise heads must have shaken when on going up to Cambridge as a classical scholar he turned aside to mathematics, and when as a mathematical master, he allowed himself to be diverted to the teaching of science

Before his Rugby career was over, Wilson contemplated giving up his comfortable house mastership for parochial work, and would have done so had not the headmastership of Clifton been offered him After a few years there, he left his successful work as a headmaster to be a northern archdeacon To many it was a matter of deep regret that no Prime Minister was ever adventurous enough to set him on the bench of bishops The one offer that was made to him was ludicrous It is possible that he might have been an admirable diocesan bishop, it is quite certain that he would have been leaven in the episcopal lump As it was, he had a great influence on religious thought, and must have been a magnet which attracted many to the Church of England and kept many in it The writer of this notice heard his first as well as his last sermon as a schoolmaster Only a few years separated the one from the other Both were instinct with the same buoyant and adventurous but steady faith In all his sermons there was a certain spiritual liveliness, which kept his congregation awake even on a hot Sunday afternoon The events of the day were seized upon to help the understanding and to show the importance of spiritual issues He paid even his youthful congregations the compliment of recognising that they had difficulties in belief, that faith could not be easy to them any more than it had been to him

Stress has been rightly laid on Wilson's ceaseless efforts to harmonise a spiritual faith with the claims of natural science As a young schoolmaster it was his task to assert these latter claims Though the teaching of science had been started in Rugby by Dr Tait in 1849, it was looked upon as an extra, and Wilson taught it as an extra to about fifty boys from all parts of the school, even as late as 1863 Then came the report of the Royal Commission on the nine public schools, including Rugby One of the recommendations of the Commission was that every boy should, at some stage or other of his school career, receive some education in science Dr Temple introduced it at once into the whole middle school, but how could one master and that a mathematical master, cope with the work? A second mathematical master—F E Kitchener—was enticed to co operate with Wilson They insisted on only one subject being taught in all the science classes for the first few terms, so that they might cope with the difficulty What was the subject to be? Temple suggested botany and botany it was, even though neither of the teachers knew the subject Wilson has himself told how the help of Sir J D Hooker, the great curator of Kew, was enlisted He planned out a course of study for the two masters for the summer term They spent the greater part of the summer holidays at Barmouth with a party headed by Prof George Henslow and many enthusiastic collectors and diagram makers, and started teaching botany to 350 boys in September 1864 From that day until Wilson left Rugby he was the inspirer of the science teaching, which was, of course, rapidly extended and no doubt botany was soon elbowed out by its more robust brothers, physics and chemistry It was not only in the work in school that Wilson was an initiator He was one of the founders of the Rugby School Natural History Society, which supplemented in almost ideal fashion the work done more formally It aroused interest in geology, zoology, entomology, and other subjects which were

not taught in the school and yet gave life and unity to the class room work and a common social bond to teachers and to taught

When Wilson went to Clifton, his experience of teaching science and his enthusiasm for it were invaluable He did not himself take a big part in the actual class work, but he collected a band of teachers and gave them the right opportunities Of these they made splendid use Their teaching owed a great deal of its inspiration to the way in which their headmaster encouraged them to do original work Scientific knowledge, the Royal Society itself, would have been poorer had it not been for the opportunities that Clifton gave its masters and its boys during the period of his headmastership

Of Wilson's work at Clifton as a whole there is much to be said Percival had laid solid and noble foundations, Wilson gave the school just the touch of inspiration, intellectual and spiritual, that carried it through the difficult second chapter of its life Men of ability still remember him as a teacher who made Plato a living power in their lives To all, his versatility and enthusiasm meant much He cared little for the solemn pomposities of life, he cared a great deal for the mortal things that touch the human mind When sorrow or shame, success or failure, visited the community—and these are from time to time inevitable visitors in any great school—he never failed in the power to show how he longed to sympathise and restore Now and then, no doubt, he bewildered his subordinates by improvised devices, or by a hurried change of opinion But bewilderment is good for all men, especially for schoolmasters He took a simple and disarming pleasure in his own feats, but was ever the first to proclaim the merits of others Thanks to this generous quality of appreciation, masters of very different and some of very great talents found happy work at Clifton In his northern parish these same qualities shone out for the encouragement of many clergymen and for the spiritual benefit of those laymen who, living among the dark satanic mills, are tempted to cease from mental strife

At Worcester, Wilson mastered a new craft that of deciphering and editing the archives in the Cathedral Library But he did not confine himself to the Library, he spoke his mind in sermons and in lectures on the urgent social problems that affected the city's life, and he imparted his own new-won love of the ancient Cathedral to countless groups of visitors, who followed him spellbound on his courteous and enthusiastic pilgrimages from end to end of the building

It is not fanciful to suppose that in his schooldays Wilson heard the two voices that speak to men of liberty At King William's College the ocean bellowed from his rocky shore, at Sedbergh the mountain floods brought him the same message and all through life he had this music in his ears and rejoiced in it To these voices others deep and vibrant were added as life brought him happiness and sorrow and quickened his imagination So it is for a very rich and venturesome nature that all who knew him are grateful and that all the trumpets surely sounded on the other side W W V

PROF A A MICHELSON, FOR MEM R S

It is just fifty years since Michelson made his first attempt to measure the velocity of the earth through the ether Shortly before his death he was still at work on the same problem The memorable result was in 1887 when, in conjunction with Morley, he performed the famous experiment that ultimately led to the theory of relativity and changed our whole conception of the physical world There was a combination of grandeur and delicacy in the apparatus which strikes the imagination—the massive pier floating in mercury and moving almost imperceptibly in slow revolution, the delicate interferometer capable of detecting a lag of one ten thousand-billionth of a second in the arrival of the light wave, and, as a climax for the theorist, the subtle escape of Nature from the trap that Michelson had set for her

I am not sure that Michelson himself was ever really convinced that this epoch-making work was not a 'failure', for he was disinclined to the new theories But he must have felt the thrill of success when in more recent times his interferometer, now magnified to colossal dimensions, gave the first measurement of the angular diameter of a star His last work reverted to one of his earliest problems, the determination of the velocity of light, I think it is not yet known whether it has realised his most cherished ambition, to determine this constant to within one kilometre per second He stands out as a man who could bring big ideas to fruition

A S EDDINGTON

IN 1899 I chanced to read in the *Journal de Physique* for that year two articles which provided no small part of my interest in life for several years, and the reading of which perhaps determined my career They contained Pellin and Broca's description of the constant deviation prism, and Michelson's of his echelon diffraction grating Michelson's first complete description is in the *Astrophysical Journal* for June 1898

The resolving power of a diffraction grating is proportional to the product of the total number of lines by the order of spectrum observed Consideration of how to increase resolving power by increase of the order of spectrum led Michelson to the idea of replacing the closely ruled reflecting lines of the ruled grating (with its spectra of the first, second, and other small orders) by the reflecting surfaces presented by the steps of a number of glass plates of equal thickness laid on each other *en echelon*, and yielding a spectrum of, say, the 20,000th order He dismissed the idea of a reflection echelon at once as impracticable, saying "The difficulty, even supposing the optical work to be practically perfect, would be the joining of the separate plates in such a way as to have always the same distance between them" But by using the same arrangement for transmission instead of reflection, he avoided these difficulties (though with some sacrifice of resolving power), and the paper describes the use of a transmission instrument to investigate the Zeeman effect

The Michelson echelon came very opportunely for the study of this (the Zeeman) effect announced by Zeeman in 1897, and was very much used during the next ten years for that and for measurements of fine structure by many observers (Galitzin, Koch, Janiki, Nagaoka, Merton, McLennan, and Zeeman himself) Latterly, the quartz Lummer-Gehrcke plate has to some extent supplanted the echelon, chiefly on account of the fact that the lines of greatest interest lie in the ultra violet, which is beyond the range of the transmission instrument Together with the Fabry Perot interferometer, these instruments have contributed in no small degree to the development of modern physics

Quite recently, Michelson's original idea of using the grating as a *reflection* instrument has been successfully realised This is more powerful than the transmission form, and can be used not only for fine structure work in the ultra-violet and Schumann regions, but also for substandard wave length measurements in these regions, to an accuracy very much greater than that hitherto available If the study of hyperfine structure, which is now just developing, fulfils the expectation of contributing to our knowledge of nuclear physics, it would seem that it is to Michelson's reflection echelon that we shall have to look for the greater share of the work F T

WE regret to announce the following deaths

Dr Alwin Berger, an authority on succulent plants and cacti, who contributed a monograph on the Crassulaceæ to Engler Prantl's "Naturliche Pflanzenfamilien", on April 20, aged fifty nine years

Prof J H Comstock, emeritus professor of entomology in Cornell University, and an honorary fellow of the Entomological Society of London, on Mar 20, aged eighty two years

Commander Sir Trevor Dawson, Bart, R N, a past president of the Junior Institution of Engineers and an authority on armaments, on May 19, aged sixty five years

Prof W D Halliburton, F R S, emeritus professor of physiology at King's College, London, and president of Section I (Physiology) of the British Association at the Belfast meeting in 1902, on May 21, aged seventy years

Dr Rudolf Marloth, who was president of the South African Association for the Advancement of Science in 1914 and author of works on the flora of South Africa

Dr Frederick Muir, known for his entomological work especially in the Hawaiian Islands, formerly president of the Hawaiian Entomological Society and vice president of the Entomological Society of London, on May 13, aged fifty nine years

Prof Louis H Pammel professor of botany in the University of Iowa, who was a vice president (Section G) of the American Association in 1919, on Mar 23, aged sixty eight years

News and Views

ON May 20, Lord Rutherford, as chairman of the Advisory Council of the Department of Scientific and Industrial Research, delivered an able and informative speech in the House of Lords on the problem and prospects of obtaining liquid fuel from coal We import, he said, liquid fuel of various kinds to the value of £40 000 000 annually, and failure of this supply would have disastrous consequences to national life So far as can be foreseen, coal is the only possible source of oil in Great Britain Two methods are known for obtaining oil from coal, carbonisation at low or high temperatures, and hydrogenation Lord Rutherford discussed the technical problems associated with low temperature carbonisation and the steps taken by the Fuel Research Board to encourage the development of new retorting systems and to modify and improve low temperature tars, so as to enable them to replace natural products Hydrogenation of tars offers promise of giving good yields of serviceable oils for various purposes, and large scale tests are to be made Much greater yields of oil per ton of coal can be obtained by direct hydrogenation of the coal, which has been shown to be technically possible The development of carbonisation and hydrogenation offer great advantages, but the main problems are economic, for natural oils are available to day in abundance and at very low prices Progress in carbonisation depends on how far the nation is prepared to pay for a purer atmosphere by using cokes instead of coal The hydrogenation process is limited by the degree of willingness of the nation to pay for independence in this matter of liquid fuels Lord Rutherford ended by saying that a full scientific understanding of this problem is more essential to Great Britain than to any other country

LORD PARMOOR, as a Government spokesman, spoke appreciatively of the importance of having in the House men like Lord Rutherford, who are able to deal authoritatively with scientific matters and expound them clearly and adequately to laymen In contrast, on the same day, the House of Commons debated the representation of the universities in Parliament Arguments in favour of ensuring representation of science and scholarship in the House of Commons were resisted in favour of the counting of heads Unfortunately, the case of the universities has been weakened by their own action in selecting members according to their political complexion rather than for their intellectual stature The debate in the House of Lords provides a good argument for the presence of scientific members in the legislature

ON May 24, Prof Einstein, after having had the degree of D Sc conferred upon him by the University of Oxford, delivered at Rhodes House his third and last lecture on the latest developments of the theory of relativity The general theory of relativity, in its original form, was defective, inasmuch as the electromagnetic field was not expressed by means of the metric of the space time continuum as was gravitation A physical basis for such a unified structure was lacking, and one could only be guided by considerations of mathematical simplicity and logical form Prof Einstein's new development depends on a modified form of the Riemann geometry, which admitted distant parallelism (integrability of the law of displacement)

The spatial structure is described by sixteen functions, and the fundamental problem consists in deducing the differential equations of the field for the sixteen vector components Actually, four types of field equations are evolved, of which two contain the old gravitational equations as special cases The other two types may be discarded Of the first two, the one which does not involve Hamilton's principle is the simpler, and Prof Einstein proposes to adopt it He also suggested that the results of quantum mechanics may follow from his new theory, whether his own speculations on the nature of space time are in accord with reality can only be settled by the very difficult integration of the equations

ACCORDING to a dispatch from the Peking correspondent of the *Times*, dated May 24, Sir Aurel Stein has left Kashgar for India, having been compelled to abandon his work in Chinese Turkestan owing to the obstruction of the local authorities He had received permission from the Nanking Government to remain in the province for a period of three years in order to explore the ancient caravan routes It would, therefore, appear that the efforts of the Chinese Society for the Preservation of Ancient Relics to secure his expulsion have been successful It will be remembered that we referred in NATURE of April 11, p 565, to the activities of this body in placing difficulties in the way of expeditions from abroad In spite of the difficulties which beset relations with China, it would be unfortunate if the matter were allowed to rest here It is not a matter which affects archaeologists alone China, as events in the last few years have shown, is becoming increasingly important in several branches of scientific research, and if international co operation has been successful in one science, a *modus vivendi* should be capable of arrangement in other fields Assuming that the Chinese Society for the Preservation of Ancient Relics is not entirely dominated by political motives, and that there is a genuine desire to preserve Chinese antiquities for China, it should be possible to arrive at an international agreement similar to those which have been framed for other countries in which the circumstances are, or were at one time, not dissimilar Such an arrangement would make possible co operation in the scientific development of the country, while preventing its exploitation When a man of science of the standing and reputation of Sir Aurel Stein is prevented from carrying on, in a perfectly legitimate manner, work which is of world wide interest and not merely of local import, the present position is obviously unsatisfactory and calls urgently for action

THE Royal Dublin Society will celebrate its bicentenary during June, as it was founded on June 25, 1731, at a meeting held in the rooms of the Philosophical Society in Trinity College, Dublin The Society at its foundation was known as "The Dublin Society for improving Husbandry, Manufactures, and other useful Arts and Sciences", and during the two centuries of its existence its activities have ranged over all the subjects included in the original title, and have been extended to include pure science, the fine arts, and music They include to day such diverse functions as the Dublin Horse Show, recitals of classical music, and the provision of radon for therapeutic purposes throughout Ireland The bicentenary celebrations will be held at the Society's headquarters at Ball's Bridge, where ample accommodation is available for the large gatherings that a membership roll of nine thousand is likely to entail during the period June 23–27 The functions will include an opening conversazione special scientific and general meetings (the latter on the bicentenary date, Thursday, June 25), a garden party, and a period ball In addition to these functions at Ball's Bridge, their Excellencies the Governor General of the Irish Free State and Mrs McNeill have kindly promised to invite the special guests of the Society to a garden party which will be held in the grounds of the Viceregal Lodge on Wednesday, June 24 An exhibition will be staged in some of the halls and grounds illustrating the advances made in agriculture, industry, science, and art in Ireland during the past two centuries An interesting feature of the bicentenary week will be the presentation to Sir John Purser Griffith of the Society's Boyle Medal, which has recently been conferred on him in recognition of his work in engineering science

Two lecture demonstrations formed a noteworthy feature of the Royal Society conversazione held on May 20 Dr William B Brierley gave a lecture on a kinematograph film illustrating the formation of an intracellular inclusion in a plant cell infected with a virus disease The preparation was made by Dr F M L Sheffield, Rothamsted Experimental Station The film showed a normal cell with its flowing cytoplasm containing the nucleus After infection the protoplasmic streaming becomes more rapid, and numerous small protein particles appear in the cytoplasm which carries them passively around the cell The particles increase in size and fuse, forming a few large aggregations, the motion of which becomes relatively slower, and after a considerable period the inclusions tend to break down, giving a number of protein crystals The second lecturette was given by Mr S R Wycherley, who showed natural colour kinematograph films made by Messrs Spicers, Ltd, of Sawston, Cambridge, the preparation of which is described on p 821 of this issue of NATURE The subjects shown included indoor and outdoor scenes photographed in the studio and out of doors, and also a film of Sir Gowland Hopkins demonstrating biochemical colour tests The tendency in these films is towards a heightening of the colours, particularly of the blue green, but the colour reproduction is, on the whole, very good, and the technical staff of Messrs Spicers, Ltd, are to be congratulated on the results achieved The fact that the films are used in an ordinary kinematograph camera and projector and are non inflammable should ensure their speedy introduction in the kinematograph industry

THE subject of Sir William Bragg's Friday evening discourse at the Royal Institution, on May 22, was "X-Ray Investigation of the Structure of Liquids"

Sir William pointed out that when a pencil of X rays is sent through a liquid behind which a photographic plate is placed, the image when developed shows not only a spot where the pencil has struck, but also in general one or more circular rings surrounding the spot. Of these optical haloes there are at least three kinds. The rainbow may be set down as one of them. Rainbow colours are due to refraction in the spherical drops, and are seen when the observer has his back to the sun. The strangely shaped haloes of the Arctic regions are due to floating crystals of ice. The third kind is represented by the corona so often seen round the moon at night. In the latter case the sizes of the coloured rings depend on the sizes of the drops of water in the cloud or mist. The smaller the ring the larger the drop must be. The result is readily explained on the principle of the interference of light, due to Thomas Young. Particularly good colour effects can be produced in the laboratory by means of artificial fogs. The wave length of the X ray bears approximately the same proportion to the size of the molecule as the wave length of light to the size of the water drop, and some of the rings on the photographic plate can be explained in the same way that the coronæ are explained. But there is undoubtedly more than that in the phenomenon. It appears that sometimes the rings are due to arrangements of the molecules of the liquid in ordered array, as in a crystal, but the arrangements are only fleeting and irregular, so that the sharp pictures obtained with X rays when crystals are used are blurred when the crystal is melted and becomes liquid. It has not been possible, until the X rays provided the means, to demonstrate in a direct manner this tendency to arrangement; it may now be possible to examine its nature and extent in various liquids. It is probably an effective factor in determining liquid properties.

We recently described a successful demonstration of the micro ray system of wireless telephony between Dover and Calais. A new system of telephony called the single side band system was demonstrated on May 21, between the wireless station at Trappes, near Paris, and the station of the Spanish National Telephone Company at Madrid. Both demonstrations were given by the engineers of the International Standard Electric Corporation. The single side band system of telephony was first used some years ago in carrier communication on wire lines. In this connexion, its main advantage is that it doubles the number of speech channels available for the same total band width as compared with ordinary modulation with both side bands. It has also been successfully used on the long wave wireless telephonic circuit between New York and London. Difficulties had to be overcome in applying the side band system to short wave work. During last year, single side band tests were carried out on the radio link between Buenos Aires and Madrid and the one connecting Madrid and Paris. It was found that the received quality was always as good as that obtained when using the double side-band and very definitely better during bad selective and fading conditions. With average fading, the improvement with the new system was at least twice as good as in normal working with both side bands. Rough tests on the improvement of intelligibility showed that it was about four times as high with the single side band system. It appears that a new system applicable to commercial working has been evolved. Mr. A. H. Reeves, the English engineer who devised the new side band system, is to be congratulated. In time, without doubt, his method will be applied to those systems of wireless communication for which narrow limits of synchronisation are essential.

We learn from a *Daily Science News Bulletin*, dated April 2, issued by Science Service, Washington, D.C., that Dr. Bruno Lange, of the Kaiser Wilhelm Institute, Berlin, has invented a new light cell, the sensitivity of which is many times greater than any at present in use. He deposits a thin layer of copper or other metal on the sensitive substance by cathodic sputtering. A wide mesh grid of metal is placed on this. By this means he is able to obtain much larger currents from the copper oxide 'sandwich' for a beam of light of given strength. Siemens and Halske are developing the new photocells, which are stated to have an efficiency at least fifty times greater than those now employed. A small experimental apparatus worked by sunlight has been driving a minute electric motor in dull daylight for some months in Berlin. It is stated that a square yard of copper oxide 'sandwich' can produce several watts of electric power when subjected to full sunlight. The efficiency of this invention will probably have to be improved many hundreds of times before it can be used to provide electric lighting and power on an economic scale. The solar generators will have to be placed in tropical regions where there is little rainfall. Like the alkali photocell, the new invention should find a large number of uses in scientific investigations and in applied science. For sound films and television it should prove very useful. It also makes telephony with infra red rays a possibility. It may lead to devices which will enable ships to signal through fogs, and aeroplanes to determine the position of the sun through thick clouds.

It is known to motorists that up to a certain limit of speed the number of cars that can be accommodated in a given length of street continually increases, but above this limit the number diminishes owing to the greater distance that has to be kept between consecutive cars. This question has recently been investigated by the traffic committee of the American Road Builders' Association. Making average assumptions, they find that at $23\frac{1}{2}$ miles an hour the number of moving vehicles that can pass over a given line drawn across the street per hour is a maximum. Above or below this speed the number of cars that pass the line per hour is less. If the cars have an average length of fourteen feet and travel at only five miles an hour, they need only keep five feet apart, and thus 1380 will pass the line in single file. If they run at ten miles an hour and are fitted with four wheel brakes the distance between them must be increased to eleven feet. In this case 2100 cars cross the line

Proceeding in this way it is found that the maximum number of 2600 cars an hour is attained when the speed is 23½ miles an hour. At a speed of 45 miles an hour only 1760 cars pass the line every hour, which is practically the same as the number that would pass at a speed of seven miles an hour, which with the modern type of car would be an uneconomical speed

THE issue of the first numbers of the *Indian Journal of Agricultural Science* and *Agriculture and Live-stock in India* inaugurates the new series of publications in agricultural and veterinary science issued by the Imperial Council of Agricultural Research, which will take the place of the *Agricultural Journal of India*, the *Journal* of the Central Bureau for Animal Husbandry and Dairying and the Memoirs and Bulletins of the Imperial Department of Agriculture in India The *Indian Journal of Agricultural Science* will be a scientific journal, issued in alternate months, and will largely replace the bulletins and memoirs, and at the same time afford a medium for material which has not been suitably provided for in the past The original articles in the first number include an account of breeding investigations on *Toria*, and papers dealing with the inheritance of characters in Indian linseed and studies in Indian barleys respectively *Agriculture and Live stock in India* is intended to be a general journal appealing to a large circle of readers During 1931 it will appear in alternate months, but it is hoped to issue it monthly in future years The original articles in this first number cover a wide range of interest and include a report on the All Burma tractor trials, a discussion on cattle breeding policy, and papers dealing with various plant diseases In addition, there are in both journals selected articles written by well known authorities on subjects likely to be of special interest and help to those engaged on Indian problems A new feature of these publications will be the abstract sections, whereby it is hoped to keep agricultural research workers in India more fully in touch with other investigators in the country, and permission has been obtained from the newly established Imperial Agricultural Bureaux to reproduce certain of their technical communications and abstracts Attention is directed to the "instructions to authors" contained in these numbers, for only with the co operation of all contributors in the manner prescribed can the Council achieve its aim of prompt publication of scientific work

THAT India has set an example to other parts of the British Empire in forest research is well known So far as research in connexion with tropical forestry is concerned, she has given a lead to the tropical world In some of our colonies and dependencies the Indian example is being followed, and we welcome the first number of the "Record of Forest Research in 1928" of the Nigerian Forest Department (*Bulletin* No 1, 1930) A commencement was made with the inauguration of an Investigation Branch in 1913 This branch started certain investigations into the composition of the growing stock in some of the better known Nigerian forests, and also into the technical and physical qualities of the common timbers The War put an end to these inquiries The first of the new research officers, who are responsible for the present bulletin, are Messrs J D Kennedy and W D Macgregor—both of whom received their forestry training at Edinburgh and, after a few years' work in Nigeria, were given a year's special course, partly at Oxford, on the Continent, and, more important, in India and Burma It was a wise step to send the future research officers to study the progress made in India, for the Indian lines of advance more nearly approach those which many of the forest services of the Empire will follow than the more stereotyped European practices, once these have been correctly assimilated The two officers returned to Nigeria in 1927, and the present report records their work during 1928 Mr Kennedy was stationed at Sapoba, in North Nigeria, and Mr Macgregor at Olokemeji The latter place was at one time the Southern Nigeria Forestry Headquarters Station, and contains much of value and interest The report gives evidence that the lines upon which sylvicultural investigations have been commenced are sound, and some interesting results may be confidently looked for It may be noted that a forest utilisation officer and a wood seasoning officer have also been added to the research staff Whilst much forestry administration and executive work remains to be accomplished in Nigeria, the Department may be congratulated on this important departure in the matter of research

AT the fifty sixth annual general meeting of the Linnean Society of New South Wales, held on Mar 25, Mr E Cheel delivered his presidential address After a review of the Society's activities, he gave a general summary of the myrtle family Upwards of 3000 species are known of the plants commonly called 'myrtles' and these are classified into 74 genera in the family Myrtaceæ The Australian myrtles are widely different from those of other countries, and they form a very important group of the Australian flora on account of the value of their timber, the medicinal and industrial properties of the species, and the utility of the berried fruits The Australian eucalypts play a prominent part in the sylvan culture of millions of acres of land in various parts of the warmer zones of the globe Some eucalypts produce tannin, practically all of the Myrtaceæ are useful bee plants, a number of species of eucalypts has given fairly satisfactory results in tests for wood pulping qualities, *Eucalyptus macrorrhyncha* has yielded a valuable dye-material, myrticolorin Many species of the myrtle family produce timbers suitable for a variety of purposes Forests of these have been exploited, without provision being made for rehabilitation, and re-afforestation is now perhaps the most important forestry problem Different groups of the Australian myrtles yield a variety of essential oils, some of which have a considerable commercial value Following the address, Prof T G B Osborn, professor of botany in the University of Adelaide, was elected president for the ensuing session

CAPT T E JOYCE, leader of the British Museum's expedition of archæological exploration in British

Honduras, returned to London on May 23 This year's expedition, which is the fifth in succession, left England at the end of last January Ten weeks were spent in the bush One of the objects of the expedition was to retrieve the stone stela from Pusilhà, containing the longest and most important of known Maya inscriptions, which had to be abandoned on the return journey last year owing to difficulties of transport and weather Two large plazas on a recently reported site, thirty miles from the coast on South Stann Creek, were explored On the south side of the central dividing mound a collapsed staircase was found, but the buildings were in a bad state owing to the perishable nature of the material, and it was probably owing to the friable nature of the surface afforded by the granite of which they were made that the numerous stelæ showed no signs of inscription On the return journey another site yielded two stone coffins made of slate slabs No bones were found in these Probably they had perished owing to the damp The pottery which had survived was of the consistency of putty owing to this cause Other finds were a finely worked and slender spear head eighteen inches long, an incense burner, jadeite ornaments, greenish stone axes, and a stone knife They are tentatively dated at about A D 500 According to a report in the *Times* of May 25, the objects found will be added to the British Museum, on the understanding that some of them will be returned to Belize should an archæological museum be established in British Honduras

THE Report of the National Physical Laboratory for the year 1930 is a quarto volume of nearly 300 pages, published by the Stationery Office for the Department of Scientific and Industrial Research at 12*s* 6*d* net As in past years, it consists of a general report of the Executive Committee and of more detailed reports from the heads of the various departments The latter give sufficient information as to the methods in use for the solution of the problems in hand, and as to the results which have so far been obtained, to allow the reader to judge for himself the importance of the work being done, whether it is of the scientific or of the industrial type In most cases these reports are provided with illustrations, which add much to their interest So far as the routine tests of instruments and apparatus are concerned, the work for the year does not differ materially in quantity from that of the previous two years, except that many more radium preparations have been examined

VARIOUS government departments continue to call on the National Physical Laboratory for information which involves new experimental work, amongst them the Air Ministry in connexion with the *R101* disaster, and the Home Office with regard to the strength of chains A large proportion of the research on scientific problems is directed by the various research associations which have been formed under the Department of Scientific and Industrial Research or by the Research Committees of the Laboratory During the year, the Laboratory has lost the services of Lord Rutherford and Sir Thomas Stanton by retirement, and of Sir William Smith and Mr Campbell Swinton by death The new physics building and the compressed air tunnel have been completed, and a new ship tank is in course of construction to meet the great demand for tests There is a strong feeling on the part of the Executive Committee of the Laboratory that the demand for work for industry should not be allowed to crowd out research of a more fundamental character which will extend our knowledge and provide a basis for future advances in both pure and applied science

THE March issue of the *Decimal Educator* reproduces the section of the *Chinese Economic Bulletin* for Oct 25, 1930, which deals with the new standards of weights and measures adopted by the National Government on Feb 6, 1929, for the whole of China The ultimate standards are the metre and the kilogram, and, during the transition period, the old weights and measures, which vary considerably throughout China, are to be unified and defined in terms of the metric standards The Sheng is in future to be the Shih Sheng of one litre, the Ch'ih is to be the Shih Ch'ih, one-third of a kilogram The British quart, pound, and yard are stated to have the approximate values, a litre, half a kilogram, and a metre respectively It is noteworthy that these approximate values given in the Chinese document should be those which the Decimal Association in Britain and the Metric Association in the United States advocate for the transition periods in those countries

SIR CHARLES CLOSE, president of the Hampshire Field Club and Archæological Society, recently addressed the Society on "On the Deadliness of Museums", and if his criticisms of the provincial museums of Great Britain were of the obvious and usual type, his suggestions, though not startlingly novel, were based on sound common sense If a provincial or local museum is to be wholly or primarily an instrument of popular education, then the ideal which Sir Charles held up to the curator in his picture of the Neolithic Room was admirably conceived He pointed out that it remains an ideal unachieved as yet in Great Britain, though he finds steps towards it in a few museums, among which, with due regard to his audience, he placed the Cloth Hall at Newbury and the new museum at Basingstoke His final suggestion is that the caretaker (presumably in such a smaller museum) might act as guide, the value of the suggestion depends on the caretaker In general, we believe that the defects of which Sir Charles complains are due not to lack of goodwill or brains in the curators, but to want of means

THE Czechoslovak National Research Council, which is incorporated in the International Research Council, and is an offshoot of the Czech Academy of Sciences, completed the seventh year of its activities at a general meeting held in Prague on Mar 21 Succeeding Prof F L Syllaba, who died on Dec 30, 1930, Prof B Němec was elected president Dr J Bašta delivered a lecture on "The Spirit of Opposition in Scientific Research", in which he emphasised that

the principle of opposition is a fundamental one both in the reactions of matter as well as in the investigator's mind

MESSRS Adam Hilger, Ltd, have issued, under the title of "Spectrum Analysis in Mineralogy", a valuable review by Dr A A Fitch of the technique of mineralogical spectrum analysis and the results that the method has so far yielded The topics dealt with include preliminary treatment of the mineral, optical apparatus, excitation of the spectrum, spectroscopic and spectrographic technique, and methods of qualitative and quantitative analysis of minerals, concentrates, rocks, meteorites, and mineral waters Reference is also made to X ray spectrum analysis of minerals and to mineral determination by means of absorption spectra A long list of examples of the elements found in various minerals by spectroscopic analysis has been compiled, with references to a bibliography of 91 items This alone makes the pamphlet indispensable to all workers in this rapidly advancing field of research Scientific workers will be grateful to Messrs Hilger for providing them with this convenient summary of technical methods and published results, particularly as the latter are scattered through a very wide range of periodicals

THE great advances made in our knowledge of the elements in recent years has led to a desire on the part of many teachers for modern periodic law charts in which this new information has been included Mr John Murray, Albemarle Street, W 1, has just published such a chart, prepared by Mr W H Barrett, of Harrow School, which should meet the requirements of teachers in schools It comprises four separate charts, one of the Periodic Table and Atomic Numbers (after Bohr), one of the Periodic Table and Atomic Weights (after Mendeléeff), one of the Periodicity of Atomic Volumes (after Lothar Meyer), and one of Melting Points and Atomic Numbers It will be seen that these new charts (which together cover an area of 6 ft by 2 ft 2 in) will serve to illustrate the main features of the modern Periodic System, and they will be found most useful in senior courses in chemistry The printing is very clear and the charts are free from unnecessary complications The price of the set, unmounted, is 5s 6d net, or mounted on linen, *9s 6d* The chart is also available mounted on linen, varnished, and on rollers, for the price of *15s 6d* net When the great advantage of such a modern set of charts is kept in mind, these prices must be considered very reasonable The diagrams are sufficiently large to be suitable for classroom teaching, and their use should considerably simplify the teacher's work

AT the annual general meeting of the Institute of Physics, held on May 19, Lord Rutherford was elected president for the year 1931–32

SIR ARTHUR EDDINGTON, Plumian professor of astronomy and experimental philosophy in the University of Cambridge, has been elected a foreign member of the American Philosophical Society, Philadelphia

A LARGE earthquake was recorded at Kew Observatory at 2 hr 27 min 0 sec G M T on May 20 It is estimated that the disturbance originated 1200 miles away, the epicentre being under the Atlantic about 300 miles west of Cape St Vincent

THROUGH the generosity of Lady and Miss Darwin, who have founded a Darwin Trust of about £275 a year, augmented by a contribution from the Medical Research Council, a study of the cause of amentia (feeble mindedness) is to be undertaken at the Royal Eastern Counties Institution for the Mentally Defective at Colchester Dr Lionel Penrose has been appointed research medical officer, and Miss Newlyn social investigator, for this investigation

AT the annual meeting of the Optical Society held on May 14, at the Imperial College of Science and Technology, the following officers were elected for the session 1931–32 *President* Prof A O Rankine, *Hon Treasurer* Major E O Henrici, *Hon Secretaries* W B Coutts (Business), E T Hanson (Papers), *Hon Librarian* Dr J J Hedges, *Editor of Transactions and Assistant Secretary* Dr J J Hedges

PROF ABDUL HAMID BEG, Islamia College, Lahore, sends us a short description of an experiment on the recomposition of white light by the use of a rotating mirror Recomposition by a rotating colour disc is not very satisfactory, as an impure white or grey is seen A better method is to use a lens, or an oscillating mirror, to recombine the colours of the spectrum of white light Prof Beg substitutes for an oscillating mirror a rotating cube having plane mirrors on its vertical sides, and his device may interest some teachers of physics

IN memory of its late editor, Prof Eugenio Rignano, who died on Feb 9, 1930, *Scientia* has founded a Eugenio Rignano Prize of the value of 10,000 Italian lire The prize will be awarded as a result of international competition to the author of the best essay on "The Evolution of the Notion of Time" The works submitted should either be unpublished, or published since 1930, and should be sent for examination not later than Dec 31, 1932 Further information may be obtained from the Editor of *Scientia*, 12, Via A De Togni, Milano (116), Italy

IN a note in NATURE of May 9 (p 714) on the Manchester earth shake of May 3, it was stated, on the authority of the local press, that the shock was not recorded at the Godlee observatory at Manchester We have received a letter from the Rev J P Rowland, *S J*, pointing out that no seismograph has yet been installed at this observatory He also gives a revised estimate for the time of the initial movement recorded at Stonyhurst, namely, 8 h 26 m 0 5 s (G M T), and the time at the origin as 5 seconds earlier The tremors were exceedingly small, the amplitude being not more than 6 7 μ

A USEFUL and well illustrated guide to the larger moths of Eastbourne appears as a supplement to *Trans Eastbourne Nat Hist, Photog and Lit Soc*, vol 10 The author, Mr Robert Adkin, has already

described the butterflies of the district, and this account of the sphingids, bombycids, noctuids, and geometrids forms the second of three instalments

We have received from the Zenith Electric Co, of Willesden Green, London, N W 2, a copy of its latest catalogue of regulating resistances These devices are well known in laboratories, and are now often used in electrical works The latest sliding type of resistance gives very fine adjustment and is cheap As they are flash tested at 2000 volts alternating, they are safe to use in electrical testing rooms

Applications are invited for the following appointments, on or before the dates mentioned —A professor of education in the University of Bristol—The Secretary and Acting Registrar, University, Bristol (June 6) A visiting teacher at the Hackney Technical Institute, for instruction to junior workers in the chemical manufacturing trades—The Education Officer (T 1), County Hall, S E 1 (June 6) An assistant veterinary inspector under the Surrey County Council to carry out duties under the several Acts and Orders relating to milk and dairies, diseases of animals, and such other veterinary duties as the council may require —The Chief Veterinary Officer, County Hall, Kingston-upon Thames (June 8) An assistant marketing officer under the Ministry of Agriculture and Fisheries —The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (June 8) A full-time teacher of general elementary science and mathematics at the Technical College, Wolverton—The Secretary, Technical College, Wolverton (June 8) A lecturer in physics at the Birmingham Central Technical College —The Principal, Central Technical College, Birmingham (June 12) An assistant lecturer in zoology in the University of Bristol—The Secretary and Acting Registrar, University, Bristol (June 13) A library assistant at the University College of North Wales, Bangor—The Librarian, University College of North Wales, Bangor (June 13) A Thomas Wall reader in comparative education at King's College, London—The Academic Registrar, University of London, S W 7 (June 15) A junior assistant (chemist) under the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (June 16) Keepers of, respectively, ethnology and geology in the Public Museums, Liverpool—The Town Clerk, Municipal Buildings, Dale Street, Liverpool (June 19) A Clothworkers' scholar in the University of Leeds for research in the physical properties of wool and other fibres—The Clerk to the Senate, University, Leeds A graduate assistant master for engineering science and cognate subjects at the Cambridge and County School of Arts, Crafts, and Technology—The Education Secretary, County Hall, Cambridge

Our Astronomical Column.

The Light-Variation of Eros—*Astr Nach* 5784 contains two papers on this subject S Taffara, of Catania Observatory, discusses the period, finding the value 0 109796 day, which agrees exactly with that announced by L Jacchia, of Bologna Most observers take this value as the half period, considering that the complete cycle contains two slightly dissimilar waves The elongation observed at Johannesburg was stated to travel round in the double period 5 h 16 m

The other paper is from Uccle Observatory, by E Delporte and P Bourgeois They determined the magnitude photographically, both by ordinary plates and by plates with a maximum of sensitiveness between wave length 5200 and 5800 With the latter plates a yellow screen was employed, stopping all light of wave length less than 4860 The curves obtained by the two methods are very nearly parallel to each other The distance between them indicates a colour index of 0 77 mag The colour has some influence on the parallax investigation, owing to differential atmospheric refraction One advance in the present parallax campaign over that of 1900–1 is that on this occasion the spectral types of the comparison stars have been determined, so that it will be possible to make allowance for differential refraction, or at least to exclude stars of type differing much from that of Eros

Absolute Magnitudes of *K* type stars—A method was recently devised by Strömberg for determining statistically the distribution of absolute magnitudes in a group of stars The requisite data are proper motions and radial velocities, or derived functions of these quantities, from which accurate values of the frequencies of different absolute magnitudes in the group can be determined Some interesting results have now been obtained by the author in applying his method to *K* type stars (*Astrophysical Journal*, vol 73, p 40) Amongst types *K*0 to *K*2, four distinct maxima appear in the frequency curve at absolute magnitudes −2 5, +0 3, +2 7, and +6 1, the largest number (78 3 per cent) being of absolute magnitude +0 3 It thus appears to be necessary to subdivide the giants into three groups of mean absolute magnitudes equal to the first three maxima, and the designations of bright, normal, and faint giants have been provisionally applied to these groups For stars of types *K*3 to *K*9 only three maxima appear, corresponding to super giants, normal giants, and dwarfs at absolute magnitudes −4 5, −0 1, +6 7 respectively

New Catalogue of Comets—Mr I Yamamoto has just published a new catalogue of comets in the current *Handbook* of Kwasan Observatory Most of the book is in Japanese, but the catalogue is in English It reproduces the orbits given in Galle's "Cometen-Bahnen", with the addition of those that have since been published, extending up to the end of the year 1930, so that it is quite up to date The elements are given to the third decimal of a degree, which is near enough for most purposes There is a useful separate table of the comets of short period, with the approximate date of their next apparition, and a list of the returns at which they were observed There are a few errata Some proper names are misspelt. Skjellerup's comet of 1927 is wrongly identified with De Vico's of 1846 Yamasaki's name is given, instead of that of Forbes, as the discoverer of 1928 IV However, there are probably no catalogues of the kind that are quite free from mistakes The book contains some other tables in English They include elements of satellites and the more interesting minor planets, and a table for converting R A and declination into galactic longitude and latitude.

Research Items.

A Saxon Sword from Wales.—Mr. C. E. Vulliamy describes in *Man* for May the discovery of a bronze ring and sword in a hut circle in the parish of Llowes in Radnorshire. The wall of the hut is marked by a low bank of turf and stones. The interior is filled with sandstone blocks of moderate size, probably fallen from the roof. A lining of massive blocks seems to have served as a revetment of the inside of the walls. A trench across the enclosure from east to west revealed the floor at a depth of eighteen inches to two feet. A small flint knife broken in two pieces and damaged by fire, and two pieces of burnt flint, were found. A surprising find was a small, thick, bronze ring, 1¼ in. in diameter, in debris above the floor in the western sector. This was followed by the discovery of an iron sword, broken in two and thickly covered with yellow rust. It was lying on the collapsed material of the wall. The blade of the sword was badly corroded and the point was missing, but it is undoubtedly Saxon and, it may be assumed, belongs to the pagan period, dating at about A.D. 400-500. The tang and shoulders correspond with datable Saxon swords of about that time. A La Tène date seems improbable, but in the absence of the pommel exact dating is impossible. The length of the sword from tang to point was probably about thirty-four inches. It is interesting to note that the find was made fourteen or fifteen miles from Offa's Dyke and eight or nine miles south of Garth Maelwys, where the Welsh are supposed to have defeated the Mercians in 723. A Saxon dagger and spear ferrule have been recorded from one of the Worlebury hut circles near Weston-super-Mare.

Important Foods of Wild Ducks.—North Dakota is a recognised and favourite resort for wild ducks, and as a consequence is much visited by sportsmen. Its selection by the birds is due to its maze of lakes, sloughs, and ponds, well stocked with suitable food and having plenty of cover. To determine the relative values, and the possibilities of the improvement of the marsh and aquatic areas as feeding grounds for the birds, a survey of the vegetation of about five hundred lakes was made by the late Douglas C. Mabbott and Franklin P. Metcalf in 1917 (*Technical Bull.* No. 221, U.S. Dept. Agric., March 1931). Although the full list of the plants inhabiting the lakes includes the names of about 350 species, the important food-plants for ducks are comprised in some 13 species. Of these, the most abundant is sago pondweed (*Potamogeton pectinatus*), found both in fresh and alkaline saline lakes, and supplying food in the form of abundant underground tubers as well as seeds. Next in importance come wigeon grass (*Ruppia maritima*) and bayonet grass (*Scirpus paludosus*), while the other most useful contributors to the diet include other species of these genera, as well as species of *Sagittaria*, *Lemna*, *Polygonum*, *Ceratophyllum*, and *Chara*. It is noteworthy that almost all the lakes contain at least a small quantity of alkali.

Rabbits and Butterflies.—In a short article in the *Vasculum* (May 1931, p. 68), Prof. Heslop Harrison directs attention to a curious dependence of the numbers of small copper butterflies upon the numbers of rabbits in certain districts. The small coppers depend for food upon the sorrels (*Rumex acetosa* and *R. acetosella*). The latter favours disturbed soils; it is the first invader to appear when whins and heather have been burnt; similarly it is the plant which thrives best among the scrapings and burrows of rabbits. Were the rabbits to disappear in certain places which the author names, the vegetation would close up, sheep's sorrel would disappear, and the small copper would follow suit. It is a series of links in a Nature chain, 'small coppers'—sorrel—rabbits, and Prof. Harrison might have added that we owe our rabbits to the Normans, so that the numbers of 'small coppers' in the British Isles may be said to depend to some extent upon the Norman Conquest!

Japanese Macrura.—Dr. Zu Yokoya describes the Macrura of Mutsu Bay in the "Report of the Biological Survey of Mutsu Bay, 16" (*Science Reports*, Tôhoku Imperial University, 5, 3, 1930. Contribution No. 55 from the Marine Biological Station, Asamushi, Aomori Ken). Thirteen genera and twenty-three species are represented, one genus and four or five species being new. Our knowledge of the geographical distribution is greatly extended, especially of certain southern forms which are now found to live in Mutsu Bay. *Penæus japonicus* is one of these. The new genus *Paraspirontocaris* is closely allied to *Spirontocaris*, but differs in its peculiarly shaped, laterally compressed rostrum projecting obliquely downwards with a rib on each side and small teeth on the upper margin, in the paired carinations of the first and fifth abdominal segments, and in the branchial formula. This new genus is created for the species *Paraspirontocaris Kishinouyei*.

Furunculosis of Salmon.—In two recent papers, a definite advance has been made in the problem of eradication of furunculosis from our salmon and trout fisheries. First, a test has been found whereby *Bacillus salmonicida* can be identified for certain; and secondly, a method for the external disinfection of salmon and trout ova has been successfully tested. Isobel Blake (I. J. F. Williamson) and Eleanor J. M. Anderson (*Fisheries, Scotland, Salmon Fish.*, 1930, No. 1) by the bacteriological test known as the complement fixation reaction have shown that *B. salmonicida* is a serologically homogeneous species. Many strains of other organisms isolated from fish and from fresh water gave consistently negative results. The general test was modified in that the immune serum was heated at 65° C. for half an hour and the complement was treated with charcoal. The first-named author has shown that acriflavine is a suitable agent for disinfecting ova which can carry the furunculosis bacilli (*Fisheries, Scotland, Salmon Fish.*, 1930, No. 2). The bacilli are only present on the outer surface of the eggs and acriflavine in a dilution of 1 in 2000 effectively kills the bacilli without causing injury to the eggs, which should be subjected to the treatment for 20-30 minutes. A method is given for the practical application of acriflavine to eggs at a hatchery on a commercial scale.

New Strains of Welsh Oats.—The Welsh Plant Breeding Station at Aberystwyth is not able to undertake the growing of new varieties of cereals on a large scale so that they may be distributed to meet a general farming demand. The Station is, however, selecting a number of pure lines from some of the commonest Welsh strains and breeding them on sufficiently to enable a comparison of growth habit and yield and behaviour from season to season. It is then prepared to bulk the produce of selected pure lines to an extent sufficient to allow a limited distribution to Welsh growers. If the new line behaves well in ordinary farming practice, then the seed supply may be increased through the farm-grown crop. Two cultivated oat varieties, commonly grown in Wales,

Ceirch Llwyd (*Avena Strigosa*) and Ceirch-du-Bach (*A. sativa*), especially the former, proved to be far from uniform when tested at the Station A number of pure lines were therefore grown from selected heads, and from these, after rigorous elimination, a few have been chosen and grown, as on behaviour and yield they showed better performance than the aggregate The work done in selecting these lines and their characters is described in leaflet S 2 from the Station (1931), by E T Jones Supplies of seed will be available for growers for planting in 1932

Interspecific Plant Hybrids and Backcrosses—The first part of a paper on this subject by E Warren (*Annals* of the Natal Museum, vol 6, part 3) deals with the selfed hybrid generation of *Venidium* and *Arctotis* and the two backcrosses, and a comparison is made of their characters with the corresponding ones in the hybrid and in the two parents In the second part certain aloe hybrids are discussed The hybrids and backcrosses are described in connexion with a statistical treatment of a series of characters, the distributions of the variable in the different generations being given in comparative tables, and by means of certain ratios a comparison, on a numerical basis, is made of the general facies of the different generations of the crosses and backcrosses The daisy hybrid exhibited greater sterility to selfing than to backcrossing, and the plants of the hybrid × hybrid generation were so sterile that no achenes capable of germination were obtained by selfing The aloe hybrids were exceedingly sterile to selfing, and no good seeds were obtained, but backcrossing was comparatively easy This fact is significant in relation to the taxonomy of aloes where hybridisation readily occurs in Nature, and there must be a considerable mixture of species in the population of aloes of many districts where various species are growing together

Ice in the Arctic Sea—The Danish Meteorological Institute has issued its report on "The State of the Ice in the Arctic Seas, 1930" In European Arctic waters there was extraordinarily little ice In the Barents Sea and around Spitsbergen open water was more extensive than in any other year during this century So early as February, the ice edge in the Barents Sea was in the normal position of May and June, and by August it was lying north of the western islands of Franz Josef Land instead of some three degrees to the south Bear Island was free from ice by April, and remained free throughout the summer From the autumn of 1929 until April 1930, the whole west coast of Spitsbergen was clear of ice After a little ice in May and June, the coast was again completely clear, and in July and August, the ice edge lay in lat 81° N During August the entire archipelago was free from ice, and there was practically no ice between Spitsbergen and Franz Josef Land The Kara Sea was clear enough to be navigable in August and September On the east coast of Greenland the ice was fairly abundant until the autumn, when parts of the coast were easily accessible Iceland was almost ice free throughout the year In Davis Strait the amount of ice was below the normal Hudson Strait and Bay were clear of ice in July and August In contrast with these comparatively ice-free coasts, Alaska and eastern Siberia had the pack ice up to their coasts for most of July and August In fact, the polar ice would appear to have been driven against these coasts rather than out into the Barents and Greenland Seas.

X-Rays without Tubes—In the March issue of the *Journal de Physique*, M G Reboul, of the Physics Laboratory, Montpellier, gives an account of the methods which have been developed in that laboratory for the production of X-rays by driving electric currents through solids of high electrical resistivities by high electrical pressures In cases in which a large proportion of the fall of potential occurs in the material either at the anode or at the cathode, that portion of the material is found to emit soft X-rays of the order of 10^{-6} cm, which become harder as the potential fall increases The electrode at which there is a large fall of potential, is given a grid form so as not to interfere with the emission of the radiation The material is used in the form of rods, about 9 cm long and 3 cm diameter, surrounded by ebonite, with an arrangement for pressing the electrodes against the ends of the rod by means of an ebonite screw Magnesia, yellow oxide of mercury, alum, and other materials have been used with differences of potential up to 30,000 volts, and X ray photographs of the usual type obtained

Spectra of Beryllium—A paper by F Paschen and P G Kruger in the *Annalen der Physik* (vol 8, p 1005), on the spectra of beryllium (Be I and Be II), closes an important gap in our knowledge of the properties of the lightest elements These spectra are difficult to produce for technical reasons, and had previously been described only incompletely, but Prof Paschen has now been able to obtain good sources both in arcs and glow discharge tubes The spectra have the structure which would be anticipated, but it is remarkable that a number of lines appear in the spectrum of the neutral atom, which show that two of the electrons can be excited simultaneously, part of the spectrum of the solar corona has been attributed recently to a somewhat similar excitation of helium In this case, it is found that the new lines are most prominent in the presence of some bands which have been tentatively ascribed to the molecule Be_2, and it is suggested that their production is connected with chemical action involving these or other molecules The ionisation potential of the normal beryllium atom is 9 281 volts, and the ionisation potential of its metastable $^3P_2$ state, 6 5675 volts

Phosphorus and Antimony Pentachlorides—Since it is impossible to represent the central atom in the molecules PCl_5 and $SbCl_5$ as surrounded by eight electrons if the five chlorine atoms are attached by ordinary co valent links each corresponding with a pair of electrons, polar formulæ such as $SbCl_4^+Cl^-$, or formulæ in which two of the chlorine atoms are held by single electron links, have been suggested Simons and Jessop, in the April number of the *Journal of the American Chemical Society*, describe experiments on the dielectric properties of these two compounds which show that their molecules possess a zero or very small dipole moment This indicates a symmetrical structure and is in favour of five co valent linkings, with a ten electron shell around the central atom An arrangement with three electron pairs in a plane and two single electron bonds at right angles to this plane is regarded as improbable, since antimony pentachloride is diamagnetic, and it is difficult to see how two unpaired electrons on opposite sides of the central atom could give rise to a mutual neutralisation of magnetic fields An interesting result was that the dielectric constant of liquid phosphorus pentachloride was smaller than that of the solid It is considered possible that the crystal forces distort the molecule and increase the polarisation The liquid has a lower conductivity than the crystalline material This result is interpreted as throwing doubt on the method of finding the polarisation of a substance by making use of the dielectric constant of the solid material

Whipsnade Zoological Park.

THE new estate of the Zoological Society of London at Whipsnade was shown to the Press on May 21. There was a private view for fellows of the Society on the following day, and on Saturday, May 23, it was opened to members of the public, who in future will each day, including Sundays, be admitted on payment of one shilling, from 10 o'clock in the morning until 'lighting up time'.

The Zoological Park, as it is called, considered merely as a place of resort in which to spend some of one's leisure, is most attractive, and from it there is a magnificent view over some eighty miles of country, rivalling that from the Malvern Hills. Much of the five hundred acres consists of downs and woodland, and it is very pleasant to think that so large a rural area is to be kept as a beauty spot.

The charm of the English landscape depends largely upon its vegetation, and the special Act of Parliament, which allows a charge for admission to be made on Sundays, forbids the picking of wildflowers, the damaging of trees and shrubs, and the throwing down of litter. 'Blue bell Wood', where there is no bush undergrowth, is at the time of writing a magnificent sheet of colour, broken only by the trunks of the trees, and there are bluebells too in the Bird Sanctuary, into which the interesting and rare plants of the neighbourhood, which are disappearing elsewhere, will be introduced. Wild birds are protected, and those which build in holes encouraged, by the provision of nesting boxes. No birds other than those usually found in the sanctuaries near London, have as yet been recorded as breeding there. In the enclosure are a few tiny antelopes (Reeves muntjac) and numerous peafowl. The writer here saw several nests of Amherst's pheasant, on which the hens were sitting, and the empty egg shells of an Impeyan pheasant which had successfully hatched out her young. Perhaps the most interesting occupants are the brush turkeys, which it is hoped will build their mounds and leave their eggs to be hatched by the heat of fermentation, as has happened in the Gardens at Regent's Park.

In the disposal of the animals generally, advantage has been very skilfully taken of the conformation of the ground and what is growing upon it. Wolves are rearing their young in a dense wood of conifers, which makes an excellent setting for them. The more scattered trees and bushes make an appropriate home for graceful Indian deer. In a more open space adjacent, and looked down upon from a causeway, is a good collection of bears.

A herd of American bison has been given a large piece of the side of a down, and little dells elsewhere have been fenced round for marmots, wood chucks, and wombats. It is intended to isolate a tableland of grass covered chalk to form a home for lions, and a good beginning has been made with the work. 'Wallaby Wood', consisting of deciduous trees, has as its name implies, been dedicated to the kangaroos. No attempt has been made to provide houses through which the public can walk for any of the animals mentioned, but shelters have been constructed into which the creatures can retire, and which can, if necessary, be warmed in winter by electric radiators.

The orchards, meadows, and the farm-land have been made into grass enclosures for the cranes and crested screamers, the wild horses, asses, and zebras, the camels and llamas, as well as the ostriches, emus, and rheas. The area of several of them is ten acres or more, and there is one of thirty acres, in which it is hoped that there will ultimately be seen a panorama of the large mammals of Africa.

In the Home Paddocks are English 'wild white cattle' of the Chartley strain, and among the herd is a black calf, which points to an occasional crossing in the past with some domesticated breed. There are also red deer, including an albino sport, and, near-by, some lion cubs bred in the Society's Gardens at Regent's Park.

The giving of considerable space to animals, the providing of them with surroundings (and in some cases, food) which approximate to those which they would enjoy in Nature, may be looked upon as mere common sense, seeing that their health should benefit and that they should look better and live longer, for many are costly and difficult, if not, nowadays, almost impossible, to replace. There are, however, other important aspects of the matter. It is allowed that people in Great Britain, at any rate, are gradually becoming more considerate towards animals. Possibly the acceptance of the theory of evolution has helped to create a fellow feeling, and there are now many whose sense of justice is strongly developed who, when they see a wild creature cooped up in a cage or living in a sty unable to roam about and fulfil its functions, cannot help comparing it with a felon imprisoned for life for some crime against society, and consider the animal to be suffering punishment which is undeserved and quite unwarranted.

These, and indeed every lover of animals, will welcome the new Zoological Park as a great advance, for here the animals can be given opportunities to produce their young, and this leads to further business and scientific considerations. Many animals, as has already been mentioned, are of considerable value, and this is especially the case where their export from their native country has been prohibited. The rearing of these and their subsequent sale or exchange may well help to maintain and improve the Zoological Park, for it is intended that any profits from it shall be used for its betterment. Then there are, unfortunately, animals which are dying out, and it may be that the only way to keep them from extinction will be to breed them in captivity.

Visitors to the Park should remember that it is only in its initial stage, and that a great deal of money had to be spent on making roads, although the Ministry of Labour supplied a hundred men from distressed areas and paid three quarters of their wages.

There are at present but few ponds, though considering the accommodation there is a good series of swans and geese and duck, with some flamingoes. It is, however, part of the plan, when funds allow, to make at least one large lake.

The Park should be a great help to the Gardens at Regent's Park. Animals which need a change of food and air can be taken there to recuperate, and any that it is desired to keep but not at the moment to exhibit in London can also be sent into the country. It may not perhaps be too much to expect that those which remain in the Gardens will get a little more room as time goes on.

The moving spirit in the whole scheme has, of course, been Sir Peter Chalmers Mitchell, and he is to be congratulated upon his achievement. This should also gladden the hearts of those whose efforts to improve the conditions at Regent's Park, years ago resulted in his appointment as secretary to the Society. Dr. G. M. Vevers, the Superintendent of the Zoological Gardens, has been staying at Whipsnade for some time, but the resident superintendent is Capt. W. P. Beal.

To follow the boundary of the estate on foot would

mean a walk of eight miles, and the Zoological Society has introduced a service of motor omnibuses of its own, inside the Park The old farmhouse and its out buildings have been made into excellent luncheon and tea rooms, but places have been set apart where visitors may picnic and enjoy the view, while refresh ment kiosks have also been provided

It is understood that motor omnibuses will bring visitors from Luton and Dunstable (which can be reached by train from London) and from the large towns within a convenient distance of the Park

WILFRED MARK WEBB

The Newfoundland Earthquake of Nov 18, 1929

THE Eastern Section of the Seismological Society of America (U S Coast and Geodetic Survey, Washington, D C) has issued two papers, by Dr Arthur Keith and by Messrs E A Hodgson and W W Doxsee, read at the 1930 meeting, at Washington, D C, on the earthquake which broke twelve of the submarine cables to the south of Newfoundland on Nov 18, 1929

The preliminary position of the cable fractures was marked in a map published in NATURE, Dec 21, 1929, and in an accompanying communication Prof J W Gregory explained the earthquake as due to the subsidence of a strip of the sea floor, probably about 400 miles long, in continuation of Cabot Strait This view is fully supported by the new papers The violence of the earthquake may be appreciated from Dr Keith's remark that it was of the same order of magnitude as the disastrous Charlestown earthquake of 1885 He concludes "that all the evidence is in harmony with the theory that parallel faults produced the Cabot trench in the past, the Grand Banks Earth quake in the present, and minor breaks like that of Sherbrooke as aftershocks" He also quotes a report by Thos S Woods attributing the boundary of the continental shelf in that region to faulting

The paper by Messrs Hodgson and Doxsee gives a useful collection of data as to the records of the earth quake, which was felt at all the chief observatories of the world The authors determine the epicentre as at lat 44° 5′ N and long 55° W, and the time there at 20^h 31^m 55^s G M T They conclude that "the evidence strongly supports the hypothesis of a down-dropped section of ocean floor bounded by two fault planes roughly parallel to the axis of Cabot Strait as defined by the 100 fathom contour, and extending from 45° N to about 39° N as a prolongation of that strait, the northern end being the more seriously displaced" The subsidence they suggest was about 25 feet

Messrs Hodgson and Doxsee (p 76) give a list of the times of the earthquake at 32 observatories The time records are of interest in connexion with the view that the floor of the Atlantic is of different material from that under the continents The earthquake records include those at Budapest, 5567 km to the east, and at Berkeley in San Francisco, 5600 km a little south of west Budapest is 33 km nearer the epicentre than Berkeley, it re corded the *P* waves 6 seconds earlier and the *S* waves 7 seconds earlier As the *P* waves travelled to Budapest in 9 min 1 sec and to Berkeley in 9 min 7 sec, the rates of transmission under North America and under the Atlantic were practically equal—the rate to Budapest being 10 29 km per sec, and that to Berkeley 10 24 km per sec The rates were to Munich, distance 5000 km, 9 9 km per sec, to Strasbourg, 4589 km, 9 3 km per sec, to Barcelona, 4700 km, 10 km per sec, and to Balboa, 4506 km, to which the direct route would have been across the deeper part of the North Atlantic basin, only 9 18 km per sec, instead of the acceleration that would be expected if that ocean floor were underlain by sima at a slight depth

University and Educational Intelligence.

CAMBRIDGE —The Appointments Committee of the Faculty of Economics and Politics has appointed C G Clark to be University lecturer in statistics

The Appointments Committee of the Faculty of Biology 'A' has appointed Dr O M B Bulman to be University demonstrator in geology

Mr John Hilton, Assistant Secretary to the Ministry of Labour, has been elected to the recently founded Montague Burton professorship of industrial relations

The Buildings Syndicate has issued a report to the University on a site for the Royal Society Mond Laboratory and on accommodation for the future development of the physical sciences It recommends that the sites of the present engineering workshops and the University power station be assigned for new buildings to contain the Royal Society Mond Labora tory, the reconstructed power station, and new workshops for the Cavendish laboratory, and that the drawing office and adjoining rooms to be vacated by the Department of Engineering be assigned to the Department of Physics

DURHAM —At a meeting of Convocation on May 20, Lord Londonderry was installed as Chancellor of the University, in succession to the late Duke of Northumberland

LONDON —New members of the Senate elected by Convocation include—Major A G Church, M P, and Prof William Wilson (science), in place of Prof F G Donnan and Sir Philip Magnus, who have retired Those reappointed by Convocation and the Faculties include—Sir Ernest Graham Little, M P (medicine), Mr Roger Smith (engineering), and Prof A L Bowley (economics)

Dr C H Lander, since 1923 Director of Fuel Research, has been appointed professor of engineering (Imperial College—City and Guilds College) as from Sept 1, 1931 Dr E L Kennaway, since 1921 chemical pathologist at the Cancer Hospital, has been appointed professor of experimental pathology (Cancer Hospital—Free) as from May 1, 1931

IT is announced by the Cape Town correspondent of the *Times* that, on May 19, the University of Cape Town conferred the honorary degree of D Sc on General Smuts, in recognition of his scientific achieve ments, and with special reference to his election as president of the 1931 meeting of the British Association

THE Rockefeller medical fellowships for the academic year 1931–1932 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1 Fellowships are awarded by the Council, in accordance with the desire of the Rockefeller Foundation, to graduates who have had some training in research work in the primary sciences of medicine or in clinical medicine or surgery, and are likely to profit by a period of work at a university in the United States before taking up positions for higher teaching or research in the British Isles In special circumstances, the fellowships may be tenable at centres of research not in America. Full particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

Birthdays and Research Centres

May 31, 1845 —Col R E CROMPTON, formerly president of the Institution of Electrical Engineers

As I was born in the country eighty-six years ago, in that part of the Vale of Mowbray in Yorkshire where farming is at its best, although I have devoted most of my life to such subjects as mechanical haulage and the supply of electricity to town users and to the greatly increasing industrial districts of England, I have, during the last few years, become more and more impressed by the far greater importance of solving the problem of increasing the food production of our farmlands and gardens, by the use of electrical power We now are all working on the somewhat difficult problem of the distribution of electrical energy at such a low cost that we should be able to persuade our farmers to substitute electrical trenching and aerification of the soil for the old time ploughing and we hope that in the not very distant future we may perfect the processes of obtaining nitrified products, such as nitrate of lime, direct from the nitrogen of the atmosphere, and at points close to where we desire to supply it to our fields, by utilising the electrical supply on the spot, instead of our farmers having to purchase the synthetic products at high cost I, for one, believe it possible that by such means we shall persuade our farmers to increase the area of arable land, and produce from it crops almost, if not quite, equal to those now produced by our market gardeners, largely by manual labour

June 1, 1866 - Dr CHAS B DAVENPORT, director of the Department of Genetics, Carnegie Institution of Washington

Since the study of heredity is really that of the internal control of development, studies on heredity in man, particularly on stature and body build, may usefully be concerned with the way individual children, of known families and races, grow, and especially with the changes in endocrine activity and other physiological factors that are associated with such growth I am, accordingly, following in individual children, during a span of years, their physical, physiological, and mental changes, to learn how they are interrelated

June 2, 1866 —Sir LEONARD E HILL, F R S, honorary director of research at the London Light and Electrical Clinic

Two years ago, working in co operation with Mr R H Davis, of Siebe Gorman, Ltd, I was able to show, with the help of the Admiralty, that it is possible for divers to go to depths of 300 ft in the ordinary living dress The necessary decompression period can be greatly shortened by the breathing of oxygen in a submersible decompression chamber designed by Mr R H Davis, and used from a depth of 70 feet upwards by the ascending diver The chief investigation I have been engaged on is assisting the Admiralty Diving Committee in working out, on animals, safe times for decompression, so using oxygen, for divers working up to thirty minutes on the bottom at 300 ft

I am also engaged in research on the penetration of the skin by infra red, visible and ultra violet rays, and the action of irradiation on the body in health and disease

June 3, 1853 —Sir W M FLINDERS PETRIE, F R S, professor of Egyptology in the University of London

The development of man's abilities and ideas has appeared to me the most interesting subject of research during the last fifty five years At present I am engaged in excavating one of the largest cities of the bronze age and the continuity into the Neolithic period As it is useless to make collections if no place is provided for them, it is to be hoped that the scheme for a study series of development in the great civilisations will be carried out in the new buildings of the University of London

Societies and Academies

LONDON

Royal Anthropological Institute, April 28 —A **Leslie Armstrong** Excavations in the Pin Hole cave, Cresswell, Derbyshire The Pin Hole excavations have been in progress since 1924 By a fortunate circumstance, this cave appears to be the only one of the Cresswell series which held the full story of the occupation of the ravine in Palæolithic times, and it was the only cave left practically intact by earlier excavators Two layers of cave earth exist, an upper level ranging in time from Upper Aurignacian to a phase which is contemporary with the Magdalenian of France This has yielded an important series of tools in flint, which reveal the gradual development of the upper Palæolithic industries of Britain, and also two examples of early art, one of which is the engraved outline, on bone, of a masked male figure The lower cave earth is in three zones, in each of which early Mousterian tools are found and definite evidence of the cave's occupation by man This lower level has also provided valuable evidence relative to fluctuations of climate during the last great ice age of Britain Many animal remains were found

Society of Public Analysts, May 6 —**E J Guild** Demonstration of a new development in filter paper The paper contains at least 99 per cent of alpha cellulose, with about 0 04 per cent of ash It is very strong when wet and offers great resistance to alkaline solution, such as caustic soda, etc It is suitable for the rapid filtration on a large scale of coarse or gelatinous substances, and also for all but the most delicate analytical work —**A J Amos** and **D W Kent-Jones** The 'rope' spore content of flour and its significance Far less importance must be attached to the rope spore content than to the technique adopted in the bakery as a factor in the production of ropy bread The conditions tending to aggravate rope trouble in bread have been separately investigated - **W R Schoeller** and **H W Webb** The separation of tin from tantalum and niobium For the separation of small amounts of tin from much earth acid, Giles's process (fusion with potassium carbonate, solution in citric acid, precipitation of tin as sulphide) is not suitable for earth acid minerals Schoeller and Powell's process (fusion with bisulphate, solution in tartaric acid, treatment with hydrogen sulphide, collection of insoluble residue and sulphide precipitate) is serviceable —**N L Allport** A new method for detecting decomposition products in anæsthetic chloroform The decomposition of medicinal chloroform, resulting in phosgene formation, leads to the presence of free hydrochloric acid due to action on the alcohol which is added as a preservative A new test capable of detecting one part of free hydrochloric acid in a million parts of chloroform is based upon the condensation of resorcinol and vanillin by the free hydrochloric acid, with the formation of a red acidic dye By subsequent treatment with alkali, a pink aqueous layer is obtained, the intensity of the coloration varying with the quantity of impurity present —**J N Rakshit** Contaminations in morphine deposited in the British Pharmacopœia process for

the analysis of opium. The morphine obtained in the determination of the alkaloid by the B.P. process contains 5·6 per cent of other alkaloids consisting principally of codeine. A modified method is described in which a lime solution of the opium is extracted with benzene prior to precipitation with ammonium chloride. This yields a much purer morphine than the original process.

LEEDS

Philosophical and Literary Society, Mar. 3.—**R. Whiddington and J. E. Roberts**: An accurate experimental determination of excitation energy by electron impact in helium. The following values with their probable error in volts were obtained, and a comparison is made with the values calculated from spectroscopic data:

Experimental	Calculated	Origin
21·24 ± 0·03	21·12	$1\,^1S_0 - 2\,^1P_1$
23·19 ± 0·04	22·98	$1\,^1S_0 - 3\,^1P_1$
23·84 ± 0·10	23·63	$1\,^1S_0 - 4\,^1P_1$

The observed values are all a little greater than the calculated ones, but by an amount more than the probable experimental error.—**E. C. Pollard**: Atomic disintegration without capture of the projectile. A discussion of energy and momentum relations is given for a process of atomic disintegration without capture of the alpha particle, and a simple picture of the detailed occurrence is put forward and tentatively considered for the elements aluminium and boron.—**K. E. Grew**: The thermoelectric power of nickel in the neighbourhood of the Curie point. Prior to an investigation of the thermoelectric properties of the copper nickel alloys, the thermoelectric power of nickel (99·97 per cent pure) against platinum at temperatures between 250° and 450° C. has been measured. Preliminary results show that the specific heat of electricity in nickel increases at the Curie point by $4 \cdot 9 \times 10^{-24}$ cal. per electron per degree, in good agreement with the value found by Dorfman and Joanns. Some irregularities in behaviour above the Curie point were observed.—**F. Tyler**: Upper limits for stellar masses—a criticism. The investigations of Anderson and Pokrowski on the upper limit for stellar masses are discussed and criticised.—**H. M. Dawson**: Reaction velocity in relation to the concentration and activity of the reacting components. The best available data for the catalytic influence of hydrochloric acid on the hydrolysis of ethyl acetate show that the velocity is proportional to the concentration of the hydrogen ion and bears no simple relation to its activity or thermodynamic concentration. The rate of conversion of N into p chloroacetanilide in solutions of free hydrochloric acid is consistent with the hypothesis that the velocity is proportional to the product of the activities of the reactants (N chloroacetanilide, hydrogen ion, and chlorine ion), but the results obtained in the presence of chlorides, when the concentration of the chlorine ion is greater than that of the hydrogen ion, show that this hypothesis is not generally applicable. On the other hand, the velocity is in all circumstances approximately proportional to the product of the concentrations of the hydrogen and chlorine ions.—**C. H. Douglas Clark**: A spectroscopic classification of the elements according to ground states. Earlier tables showing the electronic distributions within atoms derived from spectral evidence fail to exhibit the group relationships of the elements, which is especially important from the chemical point of view. A new table is therefore proposed showing the elements (rare earths excepted) in periods and groups, in relation to ground states and corresponding atomic quantum numbers, and also to electronic groups, here divided as ultimate, penultimate, and antepenultimate. The arrangement shows electronic levels in a more compact and convenient form than the schemes hitherto proposed, and forms a suitable basis for discussion of the relation existing between the valencies of the elements and their ground states.—**H. Richmond and W. H. Pearsall**: Absorption of ammonium and nitrate ions by plant tissues. Discs of potato tuber show a higher rate of nitrate absorption in more acid solutions, while ammonium ions are absorbed more rapidly in less acid solutions. Wheat seedlings show a similar type of absorption. *Eriophorum* cuttings, however, absorb more ammonia in acid solutions, and also have a much lower rate of absorption of both ions, in relation to their dry weight.—**W. Garstang**: The phyletic classification of Teleostei. The order Isospondyli is broken up, the Clupeoids being ranged with the Hyodontoids and Ostariophysi in a section termed Otophysi, characterised by a connexion, actual or vestigial, between air bladder and auditory organ, while the Salmonoids are linked with Scopeloids, Salmopercæ, Cyprinodonts, and Synentognathi, which lack all trace of such a connexion. The adipose fin, deeply rooted in the Teleostean constitution, is regarded as a vestige of the second dorsal fin (D^2) of Elasmobranchs and Crossopterygians. Its loss is almost always due to the encroachment of D^1 upon its site, rarely to simple obsolescence. This 'opisthopterous' condition characterises fishes with semi-sedentary (for example, Osteoglossoids) or lurk-and-rush habits (for example, pikes). Accordingly the loss of the adipose fin in Clupeoids indicates the derivation of this group from opisthopterous freshwater ancestors (cf. *Pholidopleurus*), while its presence in Salmonoids indicates an unbroken pedigree of wide roving forms, in which D^1 has preserved its mid-dorsal position throughout (pre-Cretaceous forms still unknown).

PARIS

Academy of Sciences, April 13.—The President announced the death of Raffaello Nasini, *Correspondant* for the Section of Chemistry.—**Léon Guillet, Jean Galibourg, and Michel Samsoen**: The resistance of ordinary steels to high temperatures. Details of measurements with an instrument described in earlier communications. The observations lead to the view that, even for steels at the ordinary temperature, there is not, properly speaking, a true elastic limit, and that the apparent permanence of the dimensions after the application of a small load is the result of the imperfection of the measuring apparatus.—**Auguste Lumière and Maurice Bourgeois**: Blocking the reticulo endothelial system and anaphylactoid shocks. Blocking and shock are two independent phenomena: they may happen together, but there does not appear to be any relation between them.—**W. Slebodzinski**: The symbolic forms of differentials.—**Henri Cartan**: The transformations of limited semi enclosed domains.—**J. Le Roux**: The invariants of the group of relative movements.—**Mlle. Yvonne Dupont**: The invariantive theory of elasticity with finite deformations.—**A. Guillet**: The disruptive state of the plane sphere spark gap in atmospheric air.—**V. Posejpal**: A theoretical formula for the absorption gap.—**Ch. Féry**: A positive electrode with gaseous circulation for batteries with air depolarisation. In the cases where the polarisation is produced by gases lighter than air (hydrogen, ammonia) the positive electrode is hollowed out and the heavier air is led to the bottom of this cavity. The usefulness of this simple arrangement has been proved in practice.—**Pierre Montagne**: The calculation of the equilibria and of the temperature resulting from the combustion of hydrocarbons. The graphical method described in earlier papers has been applied to the combustion of heptane in oxygen

—**André Meyer and Robert Vittenet** The azo derivatives of homophthalimide —**Mlle Eliane Basse** The age of the interstratified basaltic coulées in the Cretacean of the sedimentary border of Madagascar —**Mme M L Le Roux** Parasitic castration and secondary sexual characters in *Gammarus* —**Paul Wintrebert** The determination of the plane of bilateral symmetry in the egg of *Discoglossus pictus* —**Maurice Piettre** The influence of the phenomena of adsorption on the physico chemical properties of organic colloids —**Mme Z Gruzewska, and G Roussel** The amylase of horse serum in the course of numerous successive bleedings Its relations with the serum proteins

GENEVA

Society of Physical and Natural History, Feb 5 —**Léon W Collet** Results of the geological expedition of Harvard University in the Canadian Rockies (Jasper National Park, 1929) (2) The presence of Upper Lias and Bajocian in the Fernie formation of Fiddle Creek Ammonites found by the author, chief of the expedition, and his collaborators show, for the first time, that the Toarcian is represented in the Jurassic formations (Fernie) of the Canadian Rockies The complete Bajocian has also been discovered for the first time in Jasper National Park —**A Amstutz** The existence of palæovolcanic rocks in Sardinia In the course of his researches in Sardinia, the author has produced evidence of eruptions, probably palæovolcanic At the northern base of the mountain of Galtelli, he has, in fact, observed quartziferous porphyries the volcanic origin of which is clearly shown by the fluidity of the mass These rocks of effusion are prior to the Jurassic and are probably contemporary with the large Permocarboniferous eruptions of Corsica —**L Duparc** The fluorspar deposits of Martinèche and Les Isserts near Pontgibaud, Puy de Dôme The author gives a short outline of the deposit, with a hypothetical estimation of the reserves The lodes consist of fluorspar of various colours, colourless, green, and violet —**L Duparc and A Amstutz** The diabases of Mayombé and the adjacent regions (French Congo) The authors have studied the basic rocks, the age of which, relatively to the neighbouring sedimentary formations, is determined by the fact that they penetrate the crystalline schists and more recent metamorphic formations, and that the younger limestone schist series contains pebbles of these rocks They have recognised in it the ophitic, intersertal, and more rarely gabbro structures —**L Duparc and A Amstutz** The enclosure of basic rocks of Moukagni (Gabon) The authors give a brief petrographical description of rocks the dominating character of which is the presence of amphiboles and pyroxenes, enclosed in a black mica granite By analogy with other very numerous cases they consider these rocks as products of metamorphic action of the granite in the calco magnesium sediments of a layer now disappeared —**Ch Cimerman and P Wenger** A micro chemical method for the estimation of glucose in solutions and in urine A modification of Fehling's method, in which the cuprous oxide is removed by the centrifuge instead of by filtration A spot test with guaiacum replaces the ferrocyanide reaction and micro burettes are used for the volume measurements The advantages are no filtration, rapidity, and the use of small quantities of materials and reagents It is possible to estimate very small quantities of sugar in a fluid

VIENNA

Academy of Sciences, Jan 29 —**E Ullrich** Exceptional values of algebroid functions —**E Hofmann** The fruit of *Aspidosperma megalocarpon* and its opening mechanism —**F Seidl, R Enenkel, and H Nohel** Adsorption potential and phase boundary potential of highly resistant glasses —**I Felber-Pisk** The growth of isolated roots Experiments were made in the dark and in the light on the isolated roots of *Phaseolus* —**J Scholz** Atmospheric electricity (73) Theoretical investigations on the distribution of field and ions in a gas which conducts a current and also contains heavy ions

Feb 5 —**F Pauer** Contributions to the preparation of acetals Benzol glycerin (=benz aldehyde-glycerin acetal) and ortho formic acid mono-glycerin ester were prepared Both are colourless, hygroscopic, soluble fluids —**Z Dische, W Fleischmann, and E Trevani** The relation between hibernation and hypoglycæmia The blood sugar contents of active and hibernating animals, for example, of dormice, were determined Insulin was injected, producing in some cases convulsions, but not confirming the idea that hibernation could be produced —**H Schober** The spectrum of rhenium (1) The arc spectrum in the photographic region —**H Popper and O Wozasek** The glycogen content of the diabetic liver

Official Publications Received

BRITISH

Records of the Indian Museum Vol 28 Anthropological Observations on the Anglo Indians of Calcutta Part 2 Analysis of Anglo Indian Headlength By P C Mahalanobis Pp 97 149 2 rupees Vol 32, Part 4 Pp 357 495 2 12 rupees 5s Vol 33 Part 1 Pp 69 2 12 rupees 5s (Calcutta Zoological Survey of India)

Royal Botanic Gardens, Kew Bulletin of Miscellaneous Information, 1930 Pp iv+512+129 15s net Bulletin of Miscellaneous Information Appendix 4, 1930 General Index to the Volumes of the Kew Bulletin for the Years 1919–1928 Pp 78 2s. 6d net (London H M Stationery Office)

University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1929-30 Pp 22 (London H M Stationery Office) 1s 3d net

Journal of the Chemical Society April Pp iv+678 1082+x (London.)

Proceedings of the First Imperial Horticultural Conference, 1930 Part 1 Papers on the Economic and Administrative Side of Horticulture Pp. 36 1s Part 2 Papers on the Application of Science to Horticulture Pp 58 2s Part 3 Papers on Progress in Fruit Storage Methods Pp 101+11 plates. 2s 6d. (East Malling Imperial Bureau of Fruit Production)

Imperial Bureau of Fruit Production Technical Communication No 2 Field Experiments in Horticulture By T N Hoblyn Pp 50 (East Malling) 2s

Transactions of the Institute of Marine Engineers Incorporated Session 1931 Vol 43, No 3 April Pp 118 156+xliv (London)

Papers and Proceedings of the Royal Society of Tasmania for the Year 1930 Pp v+135+7 plates (Hobart.) 10s

The Indian Journal of Veterinary Science and Animal Husbandry Vol 1, Part 1 March Pp. vi+62 (Calcutta Government of India Central Publication Branch.) 2 rupees 3s 6d

Catalogue of Indian Insects Part 18 Carabidae By H E Andrewes Pp xxii+389 (Calcutta Government of India Central Publication Branch) 8.10 rupees, 14s. 10d

Botanical Survey of South Africa Memoir No 16 Forest-Succession and Ecology in the Knysna Region By Dr John F V Phillips Pp 327+83 plates (Pretoria Government Printing Office) 5s

Proceedings of the Cambridge Philosophical Society Vol 27 Part 2, April Pp 163-289 (Cambridge At the University Press) 7s 6d net

FOREIGN

Proceedings of the Imperial Academy Vol 7 No 3, March Pp vii viii+85 127 (Tokyo)

The Science Reports of the Tohoku Imperial University, Sendai Japan First Series (Mathematics, Physics, Chemistry), Vol 20, No 1 Pp 196 (Tokyo and Sendai Maruzen Co, Ltd)

Danmarks Naturvidenskabelige Samfund Ingeniørvidenskabelige Skrifter A, Nr 24 The Jet Wave Rectifier an Account of its Constructional Development during the Years 1919–1929 By Jul Hartmann Pp 300 (København G E C Gad) 30·00 kr

Journal of Science of the Hiroshima University Series A (Mathematics, Physics, Chemistry) Vol 1, No 1, December Pp. 76 90 sen Vol 1, No 2, March. Pp. 77 157 99 sen Series B Div 2 (Botany). Vol 1 Art 1 Chromosomenzahlen und Phylogenie bei der Gattung *Potentilla*. Von Naomasa Shimotomai Pp. 11 15 sen Vol 1, Art 2 Studies on the Hepaticae of Japan, IV By Yoshiwo Horikawa Pp 13-35+2 plates. 30 sen Vol 1, Art. 3 Bastardierungsversuche bei *Chrysanthemum*, I Von Naomasa Shimotomai. Pp. 37 54+plates 3-6 53 sen Series B, Div 1 (Zoology) Vol 1, Articles 1 3 Histologische Untersuchungen des Sommer- und Winterhaarkleides, von Yoshio Abe On the Corean and Japanese Wolves, by Yoshio Abe, Das Vorkommen von Echinoderes in den japanischen Gewässern, von Yoshio Abe. Pp. 43+17 plates. 95 sen. Vol 1 Article 4 A Synopsis of the Leporine Mammals of Japan By Yoshio Abe Pp 45-63+8 plates 58 sen (Tokyo Maruzen Co., Ltd)

Conseil Permanent International pour l'Exploration de la Mer Rapports et procès verbaux des réunions Vol. 72 Scientific Report of the North western Area Committee for 1928-1929 Published by Prof Johs Schmidt. Pp. iii+41+24+13+8+20 5 25 kr Faune ichthyologique de l'Atlantique nord Publiée sous la direction de Prof Joubin No 6 24 planches 4 00 kr No 7 24 planches 4·00 kr (Copenhague Andr Fred Høst et fils)

U S Department of Agriculture Technical Bulletin No 238 The Pharmacology of Thallium and its Use in Rodent Control By James C Munch and James Silver Pp 28 (Washington, D C Government Printing Office) 5 cents

Proceedings of the United States National Museum Vol 78 Art. 14 Notes on Ichneumon Flies of the Genus Polycyrtus with Descriptions of New Species By R A. Cushman (No 2857) Pp 62 (Washington, D C Government Printing Office)

Smithsonian Miscellaneous Collections. Vol 82, No 18 Tropisms and Sense Organs of Coleoptera. By N E McIndoo (Publication 3113) Pp 70+2 plates (Washington D C Smithsonian Institution)

Smithsonian Institution United States National Museum Contributions from the United States National Herbarium, Vol 26, Part 6 Asiatic Pteridophyta collected by Joseph F Rock 1920 1924 By Carl Christensen Pp v+265 337+vii xii+plates 18 29 (Washington D C Government Printing office.) 30 cents

Diary of Societies.

FRIDAY MAY 29

ROYAL SANITARY INSTITUTE (at Guildhall, Exeter), at 4 30 – E J Silcock The Exeter New Sewage Purification Works.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5 — Annual General Meeting

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section) (Annual General Meeting), at 8 – Sir William Hamer The Crux of Epidemiology

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Very Rev Dean Inge The Future of the Human Race

SATURDAY, MAY 30

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (Annual General Meeting) (at Cambridge) —E B Parsons The Action of Avertin on the Liver —S. E F Goodling The Action of Radon on Isolated Tissues —E G Holmes and C A Ashford Cerebral Metabolism —J Hellier Sensitisation of the Uterus – W E Dixon and J Heller Some New Observations on Intracranial Pressure —N Myers The Treatment of Toxæmia.—J C Hoyle The Action of Histamine

MONDAY, JUNE 1

ROYAL SOCIETY, EDINBURGH, at 4 30 —Prof H Briggs On the Relation between the Yield of Crude Oil, and the Composition of Retortable Carbonaceous Minerals —Dr C H O Donoghue Abnormalities of the Vascular System of the Anura —G L Purser The Early Stages of Development of the Vertebrates.—R. Elmhirst Studies in the Scottish Marine Fauna—the Crustacea of the Sandy and Muddy Areas of the Tidal Zone —Sir Thomas Muir Note on Cayley's Elimination Problem involving Superfluous Data.

INSTITUTE OF ACTUARIES, at 5 —Annual General Meeting

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 – General Meeting

CHARTERED SURVEYORS INSTITUTION at 5 —Annual General Meeting

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —E Maclagan Museum Planning

ROYAL GEOGRAPHICAL SOCIETY, at 8.30 —Major J H Stafford The British Italian Somaliland Boundary

WEDNESDAY, JUNE 3

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —J D H Wiseman A Contribution to the Petrology of the Metamorphic Rocks of Eastern Greenland

INSTITUTION OF STRUCTURAL ENGINEERS (at 10 Upper Belgrave Street), at 6 —The Art of Making and Using Concrete (1) Types of Cements and their Peculiarities (Lecture)

THURSDAY, JUNE 4

ROYAL SOCIETY, at 4 30 —Prof E D Adrian The Messages in Sensory Nerve Fibres and their Interpretation (Croonian Lecture).

ROYAL SOCIETY OF ARTS, at 6.—J F J Malone A New Form of Prime Mover and its Uses for Locomotives, Marine and other Engines

CHEMICAL SOCIETY, at 8.—J W Baker (*a*) Synthesis of Substances Analogous to Bile Acid Degradation Products Part I Preliminary Investigation of Methods of Attachment of Carboxylated Side chains to the Cyclopentane Nucleus, (*b*) *Reactions of ω substituted Acetophenone Derivatives.* Part I The Action of Acetyl Nitrate on ω halogeno m nitroacetophenones —K. H. Hasan and E Stedman The Constitution and Synthesis of Embelic Acid (Embelin), the Active Principle of *Embelia Ribes* —S H Bastow Adsorption of Nitrogen by Condensed Atomic Platinum —E C S. Jones and J Kenner The Direct Formation of Quinones from 2 6-disubstituted Derivatives of 4 nitrophenol

FRIDAY, JUNE 5

ROYAL SOCIETY OF ARTS (Indian Section) at 4 30 —Mrs Patrick Villiers Stuart The Indian Paradise Garden (Sir George Birdwood Memorial Lecture).

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr H C Hepburn Electro-osmosis and Electrolytic Water transport. Part 2.—J S Badami Spectra of Trebly and Quadruply Ionised Antimony Sb IV and Sb V —G I Finch, R W Sutton, and A E Tooke; *A Time Base for the Cathode-ray Oscillography of Irregularly* Occurring Electric and Magnetic Phenomena.—Dr R. L. Smith Rose and J S McPetrie The Attenuation of Ultra short Radio Waves due to the Resistance of the Earth —Prof S Chapman The Absorption and Dissociative Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth Part 2 Grazing Incidence —A Ripple tank Demonstration of Beats as Moving Interference Fringes, by M O Clarke

GEOLOGISTS ASSOCIATION (in Architectural Theatre, University College), at 7 30.—R O Jones The Development of the Tawe Drainage —Dr S W Wooldridge and C J C Ewing Further Observations on the Geology of the Lane End Eocene Outlier

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at Kensington Town Hall), at 8 15 —Prof J S Huxley *Development in Relation to Heredity* and Evolution (Cavendish Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof E W MacBride Habit—the Driving Force in Evolution

ROYAL SOCIETY OF MEDICINE (Laryngology Section) —Morning and Afternoon

PUBLIC LECTURES.

FRIDAY, MAY 29

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —N Howard Mummery An Industrial Welfare Scheme

SATURDAY MAY 30

UNIVERSITY COLLEGE, LONDON, at 2 30 —Sir Flinders Petrie The City of the Shepherd Kings (*To be repeated on June 2 at 5 30*)

MONDAY, JUNE 1

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr F C Shrubsall Mental Deficiency from the Social, Legal, and Educational Aspects.

TUESDAY, JUNE 2

LONDON SCHOOL OF ECONOMICS, at 5 —Prof L. March La methode statistique et ses applications à la Science des affaires (1). (Succeeding Lecture on June 4)

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr C J Thomas Physically Defective Children (1).

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital W 2), at 5 —Dr A. Gratia The Schwartzman Phenomena.

THURSDAY, JUNE 4

CHELSEA PHYSIC GARDEN, S.W , at 5 —Dr T F Chipp Trees and Man (Chadwick Lecture).

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Dr C J Thomas Physically Defective Children (2)

FRIDAY, JUNE 5

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —R R Hyde Industrial Welfare.

CONGRESSES.

MAY 27 TO 29

CONFERENCE ON MENTAL HEALTH (at Central Hall Westminster)

Friday, May 29, at 5 —The Human Factor in the Social Services
At 8 15 —The Human Factor in Education

MAY 28 TO 30

VEREIN DEUTSCHER CHEMIKER (at Vienna) —Symposium The Separation of Liquids and Solids.

JUNE 1 TO 5

INTERNATIONAL FEDERATION FOR HOUSING AND TOWN PLANNING (at Berlin).—International Housing and Town Planning Congress

JUNE 2 TO 5

INSTITUTION OF GAS ENGINEERS —ANNUAL GENERAL MEETING AND INTERNATIONAL GAS CONGRESS (at Institution of Civil Engineers)

Tuesday, June 2, at 10 A M —Annual General Meeting
Presidential Address.
J S Thorman Intermittent Vertical Chambers and Coal and Coke-handling Plant at Southall
At 2 30 —Dr H Schütte Problems of Modern Gas Distribution
A L Holton The Semi-direct Recovery of Ammonia in Gasworks Practice and the Recovery of Tar Acids from Ammoniacal Liquor

Wednesday, June 3, at 10 A M —C E Paige The Gas Industry in America.

Thursday, June 4 —Dr R. Lessing Clean Coal in the Gas Industry
R. N Webb An Experiment in Controlling Pressure Conditions within Coal Gas Retorts.
At 2 45 —J H Clegg The New Oswald Street Gasworks of the Burnley Corporation

JUNE 3 TO 5

ELECTRICAL ASSOCIATION FOR WOMEN—INTERNATIONAL CONFERENCE (at Glasgow).

Wednesday, June 3, 7 30 to 10.30 P M (at Central Hotel) —Informal Reception

Thursday, June 4, at 10 30 A.M (at Royal Technical College).—Short Papers by representative women, including the following from Overseas —Madame Silfverhielm, Mlle Paulette Bernège, on Electrical Education.

Friday, June 5, at 12 noon (at Royal Technical College) —A. E McColl The Grid in Scotland

SATURDAY, JUNE 6, 1931.

CONTENTS.

Editorial and Publishing Offices
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Railway Electrification.*

THE Report of the Committee on Main Line Railway Electrification, of which Lord Weir is chairman, has now been published, and the conclusions reached in it are clear and far-reaching It is satisfactory to find that several of the consulting and railway engineers examined arrived at practically the same numerical results in making estimates

The Report states that electric traction has shown itself to possess definite elements of superiority over steam traction, and that the system is extending wherever it has been adopted

It is pointed out that the progress which is being made by the national scheme for supplying high pressure electricity in bulk and in forming a Central Electricity Board has introduced new factors into the problem of main line electrification The Committee was justified, therefore, in undertaking a comprehensive review of the economic possibility of changing from steam to electricity In making this review, it was assumed that the productivity of the country is ever increasing, and so a transport service must be provided capable of expansion both in method and efficiency The high standard of living adopted in Great Britain has also to be borne in mind

During recent years the revenues of the railways have diminished most seriously, largely due to the growth of road transport for goods and passengers and to the long period of depression in many industries, but nothing has happened as yet to make it at all likely that the railways will be displaced from their position as the chief agency for the transport of goods and passengers in Britain Assuming this, the Committee has attacked the problem and made careful estimates of the extent to which a change from steam to electric traction on our railways would be justifiable and economic

There are many railways abroad operated by electricity and many more are under construction In nearly every case, investigation shows that there are reasons due to special circumstances which induced the country to adopt electric instead of steam haulage, and few of these reasons apply to Great Britain The outstanding example of railway electrification is the Swiss Federal Railway system In Switzerland, 66 per cent of the total mileage is operated electrically and this carries 85 per cent of the total traffic In this case, the main factors governing the choice were the desire to be independent of foreign countries

* Ministry of Transport Report of the Committee on Main Line Railway Electrification, 1931 Pp 57+2 plates (London H M Stationery Office, 1931) 3s net

for supplies of coal and the abundant water power available In addition, there are many steep gradients and long tunnels and these made electric traction almost a necessity It is computed that in 1929 the adoption of electricity effected a saving of £200,000, taking all interest and amortisation charges into account This saving will doubtless increase rapidly as the traffic increases It has to be remembered that in Switzerland the power stations were built by the railway and the interest on their first cost is taken into account in the estimate given above of the saving effected

In France, the main considerations taken into account when electrifying the Paris Orleans railway were the high price of coal south of Paris and the development of the water power sources of central France The linking of this large source of power with Paris is in the interests of national policy It is doubtful whether the railway is yet remunerative The Midi railway electrification utilises available water power, but it obtains a substantial revenue by selling electrical energy to dwellers near the railway and to factories When this latter sum is taken into account, it shows a profit The various electrifications in Germany are due mainly to a desire to utilise available water power There are also many steep gradients and long tunnels which make electrification desirable In Italy and the rest of Europe, similar considerations favour electrification In the United States, there is, in addition, the urgent necessity of increasing the traffic capacity of many of the railways We also see that in some cases the capital cost can be considerably reduced by utilising the 'air space' in large electric stations by building flats and offices above them With steam trains this would be impossible

In Great Britain, the important advantages accruing from the suburban electrification of railways in large towns are now obvious Taking a group of eighteen stations on the Southern Railway within twenty miles from London, it was found that, four years after they were electrified, the number of season tickets issued had increased by 140 per cent It is satisfactory to learn that all electrifications of suburban railways in Great Britain have been uniformly successful The experts calculate that the capital required for the complete suburban electrification of the country, spread over twenty years, would be 45 million pounds The saving effected by electric over steam haulage would be 13 per cent per annum in the twenty-first year There would, of course, be a steam electric period for twenty years But the increased revenue due to electrification would cover the temporary costs of dual working, in addition to paying the interest charges averaged over the whole programme We can assume, therefore, that the railway companies will, in due course, extend the electrification of their lines round London and other large centres The schemes at present in hand strongly support this assumption

The problem of main line electrification in Great Britain needs to be specially considered, as there is little available water power, coal is cheap, tunnels are few, and there are very few appreciable gradients The Committee, therefore, had estimates made by independent experts The major part of the cost of haulage is the cost of the energy expended In steam haulage, this is represented by the cost of the fuel, which in Great Britain is coal In electric haulage the corresponding item is the price paid by the railway for electrical energy The experience gained in only a few other countries is, therefore, applicable The Committee knows that the energy can be purchased from the Central Electricity Board, and it has adopted the overhead direct current system of electrification at 1500 volts as the standard Although the substations will be worked by the railway employees, the cost of their erection and maintenance will be paid by the Central Electricity Board

The essential characteristic of electrification as compared with all other traction systems is the removal of the generation of power from the train From this fact arises most of the advantages and economies of electrification Before a line is electrified, a heavy new interest charge is incurred on fixed equipment, and the independent coal burning locomotives must be replaced by dependent electric haulage units

Estimates made by H W H Richards, J M Kennedy, and Messrs Merz and McLellan indicate that the total capital cost of railway main line electrification in Great Britain would be 261 million pounds, and that the net savings effected would be nearly eighteen million pounds per annum Assuming general electrification on a twenty-year plan, and that existing traffics were maintained, this would lead to a surplus of approximately two per cent after paying the fixed charges on the new capital involved From a business point of view, such a result taken by itself would not warrant the adoption of a scheme of this exceptional magnitude The Committee points out that it has left out of account many things the money value of which cannot be assessed For example, were it completed the railway companies could offer the public

a speedier and much more satisfactory service than they can under steam haulage. Any increase in the service will secure increased savings as compared with steam. It has to be remembered also that British electrical manufacturers have completed many important contracts for railway electrification in many different countries. If the electric scheme is adopted, the experience they have gained would be at once available. With the exception of the raw copper, practically all the expenses would be distributed as wages in Great Britain, and would employ 60,000 men for a period of twenty years. The Committee thinks that notwithstanding the great saving in wage costs effected by electrification, yet there would be little risk of the employees occupying the grades of drivers, firemen and cleaners being adversely affected because of the considerable intensification of suburban services. The physical conditions under which the traction staff would work would be much more favourable than at present.

Apart from its effect on the railways, an electrification scheme on the lines indicated would most favourably affect the National Grid, which is already proving a boon to Great Britain. As to the risk of some more economical method of generating electricity being discovered by science, this discovery would not affect railway economics much, as they would be purchasing electricity and the efficiency of conversion of electrical machinery now approaches a hundred per cent. We have little sympathy with those who oppose the scheme on the ground that new discoveries are continually being made by science. They remind us of the slothful man in Proverbs xxvi. 13, who was continually saying, "There is a lion in the way; a lion is in the streets."

Prehistory

Weltgeschichte der Steinzeit. Von Prof. Oswald Menghin. Pp. xvi + 648. (Wien: Anton Schroll und Co., 1931.) 40 gold marks.

PROF. MENGHIN has taken ten years in the preparation of this extremely important book, and he has certainly not wasted his time. Quite probably it is the last serious work, bearing such an ambitious title, which will ever be written. For it is one of the tragedies resulting from the increase of knowledge, that a general survey of a subject becomes less and less possible. Field workers are, as it were, bricklayers whose position, so close to the small section of wall they are building, makes any general view of the edifice as a whole impossible; and, even for those who are less concerned with the actual building, the structure of knowledge has become so vast and is growing so rapidly as to make a comprehensive study of the whole a very difficult task.

However, Prof. Menghin's book is not only to be welcomed because the Stone Age prehistory of the world is surveyed; quite equally interesting are the new methods of approach to the subject which are here for the first time put forward in print. I say "in print" of set purpose, because in Great Britain several of the same ideas, at least in a modified form, have for some time past been 'in the air', and indeed are already being taught by professional prehistorians. Prof. Menghin, however, has now elaborated and codified these ideas. Briefly, the new schemes depend upon a considerable stressing of the typological method of classification as applied to the Palæolithic and Neolithic cultures as a whole. Prof. Menghin distinguishes, from the earliest times, core, flake, and bone industries, and urges that they are the expression of different modes of life practised by different cultures. The separation of bone using cultures (such as the Maglemosean) is his own special contribution to the new method of approach and one which leads to interesting results—the distinction in Lower Palæolithic times between core—that is, hand axe—(Chelleo-Acheulean) and flake (Clactonian, Levalloisean, etc.) industries has been recognised for some time, also the suggestion made that they belong to different cultures.

Prof. Menghin regards flake industries, such as those already named, as being ancestral to the blade industries such as those of the Upper Palæolithic. Yet surely there is a real distinction between the two, and further, Upper Palæolithic blade industries are associated with burins, forming what can well be described as 'Blade and Burin' industries, a fact which is never the case in Lower Palæolithic flake industries. The difference between a flake and blade is no doubt slight; but it does seem to be a real one. The intriguing suggestion is made that hand axe folk, from the nature of their club-like tools, must have been originally cradled in forest lands, while the dagger and lance points of flake industries postulate a steppe country as the area of origin of the folk who made them. Such generalities are audacious and can sometimes be refuted in detail; but are yet fascinating and often contain important elements of truth.

Another nettle that Prof. Menghin has attempted to grasp is that of Stone Age nomenclature. Quite clearly the world-wide application of terms derived from French place names such as Chellean—there is

scarcely any true Chellean at Chelles—is absurd Moreover, the distinction between the Chellean and the Acheulean cultures is only one of evolution, while between the Acheulean and the Mousterian a much greater gulf exists, a fact which is in no way suggested by the older terminology Again, the classic nomenclature is difficult to apply when the new methods of approach indicated above are adopted Prof Menghin has therefore started *de novo*, but his suggested alternatives are somehow not always happy Nomenclature should be informative, and if possible descriptive, it is true, but need the terms used be in themselves ugly and jaw breaking? "Chwalibogowician" as a name for certain sub-dune Polish industries has been replaced by the name "Swiderian", partly perhaps as a result of slight discord between certain Polish archæologists, but largely because the former word is difficult to spell and impossible to pronounce In Prof Menghin's nomenclature, however, there occur such terms as "Epimiolithic", "Opsimiolithic", 'Epiprotoneolithic", and "Epimixoneolithic"—all quite intelligible if time is taken to think out their implications, and each, in itself, more unattractive than the last Because geologists and petrologists are such sinners in this respect, must prehistorians follow their example? Again, the terms "Protolithic" and "Protoneolithic" are easy to distinguish when written, but can be readily confused in conversation Compare, in this connexion, the trouble that has so often arisen already in the use of the terms Neolithic and Eneolithic

The "Weltgeschichte der Steinzeit", though imposing in contents, is in size and shape convenient enough to handle, and is nicely produced After a brief introduction and a discussion of Stone Age chronology, there is a long chapter on Prof Menghin's first period, the Protolithic This includes everything that has hitherto been classed as Lower Palæolithic and Mousterian The threefold subdivision into core, flake, and bone cultures is explained and adopted, the geographical distribution, evolution, and interaction of each of these groups being considered Incidentally, the author expresses a fairly general scepticism with regard to the Tertiary eoliths Chapter iv contains another detailed account of his next period, the Miolithic, which embraces the Upper Palæolithic and Mesolithic cultures The core, flake, and bone subdivision is continued and elaborated Naturally, the worldwide interactions of these three cultures, now become very complicated as influences from surviving Protolithic predecessors, have to be taken into account and the number of possible combinations and fusions is very great A simple example of such culture crossing is the Solutrean, which is here discussed and analysed It is regarded as the result of a mixture of flake and core culture streams, the one a dagger and lance culture addicted to magic rites and having a tendency to naturalistic art, the other a club-culture with a mother-god cult and a preference for schematic decoration Typically, a Miolithic core culture is the Campignian which it is suggested may have been cradled in Iran Prof Menghin will not tolerate the idea that essentially it is a northern culture The Maglemosean and Arctic cultures are, of course, bone-Miolithic

Next follows a chapter on the Protoneolithic which includes polished axe cultures, as well as those of Anau I and the Gobi Here a somewhat different subdivision is suggested, namely, into cultures specially interested in pigs, cattle, and horses ("Reittierzüchterkulturen") As before, geographical origins, distributions, and interactions are discussed We are thus prepared for a consideration of what is called the Mixoneolithic (= the older 'full Neolithic'), which is divided into village, town, and steppe cultures Finally, there are two chapters dealing with ethnographic linguistic and racial problems in relation to palæo archæology, followed by general conclusions

While perusing this really monumental work, one is constantly impressed—almost appalled—by the amount of material that Prof Menghin has read and absorbed He has also travelled Doubtless many of his details will have to be corrected by field investigators working intensively in various countries, and one feels that he has perhaps dismissed too lightly one or two somewhat thorny problems, but the whole work suggests a new and fascinating approach to the study of prehistory

The typologist is in somewhat the same position as the grammarian He has to systematise a great deal of material and arrange so far as possible that the rules he lays down agree with the facts of reality It has lately been recognised that the current grammar of prehistory is increasingly inadequate —our knowledge of the subject having grown so rapidly in recent years Whether Prof Menghin's new grammar (1) coincides with reality and (2) is sufficiently workable for the purposes of students, the future alone will show While it undoubtedly constitutes a great advance on the earlier schemes, certain factors, such as climate, which tend to produce similar needs and therefore similar industries, are not much stressed or allowed for Moreover, the influence on the final appearance of an industry,

which is exerted by the kind of raw material which is readily available, is a factor which must often be taken into consideration Industries rich in antler-sleeves do not occur when there are no deer There is indeed no need to believe that all somewhat similar industries must necessarily be derived from the same originals For working purposes, the loss of the Mesolithic as a definite stage is perhaps to be regretted Throughout this period, the conditions of life, in Europe at any rate, differed radically from what came before and afterwards Arbitrarily to draw the line at the close of the Mesolithic cultures, and not to make a similar division at the end of the Palæolithic, does not seem to be altogether helpful

But I must reiterate that this is a monumental and remarkable work, which ought to be translated into English It is full of new ideas, and its perusal rather takes one's breath away Prof Menghin is indeed to be congratulated on its production It contains, by the way, plenty of excellent illustrations M C BURKITT

Climate General and Local

(1) *Climate a Treatise on the Principles of Weather and Climate* By W G Kendrew Pp x + 329 + 12 plates (Oxford Clarendon Press, London Oxford University Press, 1930) 15s net

(2) *Die Klimate der Erde* Von Alfred Hettner (Geographische Schriften, Heft 5) Pp iv + 115 (Leipzig und Berlin B G Teubner, 1930) 5 40 gold marks

(3) *Klimakunde von Südamerika* Von Prof Dr K Knoch (*Handbuch der Klimatologie*, herausgegeben von W Koppen und R Geiger, Band 2, Teil G) Pp viii + G349 (Berlin Gebruder Borntraeger, 1930) 67 50 gold marks

THESE three books on climatology, appearing within a short time of each other, meet three different needs The first is for the general reader as well as the teacher, the second is for the teacher and student, and the third for the specialist and librarian

(1) Kendrew's "Climate" is an exceedingly well written and well illustrated general introduction to the subject The distribution of the climatic elements over the globe and the causes of their variation from place to place are described clearly and simply, while the more noteworthy phenomena are illustrated by photographs and quotations in a way which will commend the book to teachers of geography The later chapters, on local details of climate and some typical climatic regions, are also good, and are supplemented by a valuable series of representative weather charts The description of the weather of the temperate storm belts and its basis in the storm-building conflict of 'polar' and 'tropical' winds introduce the modern idea of the 'polar front', which, however, the author does not entirely accept

There are a few slips, for example, "when the path of the sun's rays through the air is doubled the heat received is reduced to a quarter" (p 9), the theory of the deflection of winds by the earth's rotation on p 73 is quite inadequate, and the air temperature need not be above freezing point for the formation of glazed frost (p 213) In Fig 32 we are shown the old diagram of the planetary winds, which Sir Napier Shaw showed to be inaccurate many years ago, and beneath it, an even more impracticable reconstruction of the upper winds It is true that the diagrams are followed by a word of warning, but it is high time that these obsolete illustrations were abandoned altogether by the writers of text books and replaced by something more modern Most of the book is reliable enough, however, while the general get-up, printing, and indexing are all excellently done The volume should find a place on the shelves of all those who are interested in meteorology

(2) Hettner's book, 'Die Klimate der Erde", is a typical German handbook, very complete, very systematic, and very dry Along with solar radiation, atmospheric circulation, water vapour and temperature, it even includes chapters on the chemical composition and dust content of the air and on light and the colour of the sky To cover all this, as well as an outline of the climate of the continents, in a hundred and fifteen pages, requires a very compressed treatment, and while most of the book is clearly written, simplification is sometimes carried too far Thus, the statement on p 16, that the warming of the air depends on its density, ignores the preponderant influence of water vapour, and the reader of the paragraph on the chemical composition of the air will be little wiser for his pains The old fashioned diagrams of the planetary circulation reproduced by Kendrew are also included by Hettner

On the climatic side, the author is much more sound, and his bird's eye view of the climatic provinces is the best part of the book Its value is increased by the numerous clear illustrations, which will appeal to economic geographers and naturalists seeking to correlate their data with meteorology There is no index, but in a work of this nature it is scarcely necessary

(3) The "Klimakunde von Südamerika" falls into quite a different category It is the first instalment of a comprehensive treatise on the climatology of the globe on a scale never before attempted For many years, Hann's famous "Handbuch" has stood as the great work of reference on the subject, with authoritative tables, abundant references, well chosen quotations, and clear discussions of scientific principles But the third edition of the "Handbuch" appeared in 1911, and in the intervening twenty years many more data have been accumulated and much new knowledge gained The task of revision was beyond the powers of any single individual and has accordingly been divided among many The new "Handbuch" will consist of five volumes, one general and four regional, the editors of the whole work are the veteran climatologist, Dr Koppen, and Dr Geiger, of Munich, but each region or continent is assigned to the best authority on its climate The list of authors includes no fewer than thirty five names, most of them known to all meteorologists All the regional volumes are to be on a definite plan, especially the collection of tables, which is regarded as an essential feature of the work, of equal importance with the text

If we may regard Dr Knoch s treatment of South America as representative, the new "Hand buch" will indeed leave little to be desired Beginning with the growth of climatology in the continent, he discusses the geographical factors such as orography and ocean currents, describes the distribution of the climatic elements, and con cludes with detailed climatological accounts of the various countries The treatment throughout is wonderfully thorough, the relegation of most of the tables to the end has permitted a very full development of the descriptive side, partly by quotation and partly in concise summary, with full references to a bibliography of 570 entries There is not a large number of illustrations, but those given are valuable, the distribution of rainfall, for example, is illustrated by no fewer than seven full-page charts The tables occupy eighty pages and include not only monthly normals of all climatic elements, including the frequency of 'phenomena', but also variations of pressure, temperature, and rainfall from normal at selected stations over long periods The figures are reasonably up to date, and the collection of all this material must have been a gigantic task The arrangement, which is by elements, involves much turning over of pages, but, no doubt, arrangement by stations, preferable in theory, would have required too much space

We owe the utmost praise to Gebrüder Borntraeger for their courage in undertaking the publication of a work of this magnitude, no less than to the editors for the broad lines on which it is planned, and, in this beginning at least, to Dr Knoch for the generous way in which the plan has been carried out Few private readers will be in a position to purchase the complete series, but no meteorological, geographical, or reference library can afford to be without it A stout binding should be provided, for the books will be much handled

C E P B

Mathematical Tables and Formulæ

Standard Four Figure Mathematical Tables including many New Tables, Trigonometrical Functions for Radians, Inverse Trigonometrical and Hyperbolic Functions, and an Extended Table of Natural Logarithms By Prof L M Milne-Thomson and Dr L J Comrie Edition B with Negative Characteristics in the Logarithms Pp xvi + 245 (London Macmillan and Co, Ltd, 1931) 10s 6d net

THE object of the authors of this volume of mathematical tables is "to supply a comprehensive set of tables of the numerical values of the elementary functions which are in constant use in mathematics and in the applications of mathematics to physics, chemistry, astronomy, engineering and statistics in those cases where four figure accuracy is sufficient" To attain this object, nineteen tables, occupying 213 pages, are given In each table the authors have endeavoured to supply as complete information as possible of the values of related functions of the same argument, for example, at one opening the computer will find the first five powers, square roots, cube roots, and reciprocals of 100 arguments

A large number of new calculations were made to seven figures and reduced to four figures with the usual convention Many of the tables are claimed to be new, but these are not specified The method of building up these tables and of proof-reading was such that computers may be assured that the accuracy of the tables is high The names of Prof Milne Thomson and Dr Comrie are, in fact, sufficient assurance that the tables have been accurately calculated and printed

For interpolation purposes, first differences are printed where they are useful, and where these become inconveniently large, an alternative method of interpolation is given in some form at the foot

of the page concerned In general, the amount of interpolation required is small For the sake of increased accuracy in working to four decimal places, signs are placed after the tabular results to indicate the possible error involved in the 'cutting down' process A high 'dot', no sign, and a low 'dot' cover a unit of the last figure for this purpose If these signs are used, the results will generally be more accurate

The argument in all the tables has an extensive range and the interval is generally sufficiently small to make interpolation simple Logarithms, antilogarithms, addition and subtraction logarithms are followed by square and cube roots, powers to the fifth and reciprocals of n from 1 00 by steps of 0 01 to 12 00, with additional columns giving square roots of $10n$ and cube roots of $10n$ and $100n$ A table of several functions of the first 100 integers, including logarithm of the factorial and probable error, follows Natural and logarithmic trigonometrical tables for arguments at intervals (i) of 0 01° and 0 1°, (ii) of minutes, (iii) of 0 001 radian, are followed by tables of natural and logarithmic hyperbolic fractions, powers of e, and an extensive table of hyperbolic logarithms Inverse circular and hyperbolic functions, gudermannian and inverse gudermannian, the logarithm of the Gamma function, and the function erf x are the most important of the remaining tables

The main tables are followed by twenty-six pages of derivatives, integrals, series, formulæ, standard differential equations, mensuration, etc This part of the volume will be useful for reference purposes, and a detailed index at the end of the volume would have enhanced its value

An extensive table of proportional parts is provided at the end of the volume and an additional copy can be removed and placed alongside the table in use

The tables are printed very well with the figures of the standard type in modern tables and on very good paper Some of the pages appear rather 'crowded', but not sufficiently so to cause undue fatigue in the user of the tables The book is sold in strong binding

Notation Throughout the volume the logarithm to the base 10 is printed 'log' and the logarithm to the base e is printed 'ln' The choice of notation is not a happy one, for in mathematical text-books 'log' generally signifies the logarithm to the base e This will not be a handicap to the computer when he becomes familiar with it Throughout this edition, negative characteristics are given in the logarithms where necessary, and the writer favours this method of printing the characteristic, a companion edition in which positive characteristics are used is also available

The work of the authors provides an exceedingly useful collection of tables for the large number of computers for whom four-figure accuracy is sufficient

Mammalian Genetics

The Genetics of Domestic Rabbits a Manual for Students of Mammalian Genetics and an Aid to Rabbit Breeders and Fur Farmers By Prof W E Castle Pp vi + 31 + 13 plates (Cambridge, Mass Harvard University Press, London Oxford University Press, 1930) 6s net

AMONG the fanciers and the commercial breeders of the rabbit, there is an increasing number of those who are inclined to agree that a working knowledge of Mendelism is distinctly helpful in the production of new varieties and in the fixation of those which already exist So far, their interests have been served, though imperfectly, by frequent articles in those publications which address themselves to the rabbit keeper, but the need for a small yet comprehensive book on the genetics of the rabbit has during recent years, become manifest Prof W E Castle has written a book which is the first serious attempt to include within one small volume all that is known of the genetics of domestic rabbits, and to indicate how this knowledge may be incorporated profitably into breeding practices

In reading this book, and at the same time continually reminding oneself that the rabbit breeders, of Great Britain at least, are not at all conversant with many of the terms and notions that to the trained geneticist are commonplaces, one is forced to the conclusion that the rabbit breeders of the United States must have a greater knowledge of present day genetics than those in this country The book can thus be of value only to a very few of those who seek and need a simple presentation of fact and theory

To the few, however, the book will prove of very considerable value There is, for example, a chapter entitled "Criteria of True Breeding Types and Individuals", containing a table which shows at a glance the hereditary constitution of the different varieties, and an account of the different mutations that have occurred is placed before the reader in a clear and concise manner No reference is made, however, to the two distinct mutations each of which produces the Rex type of fur, though

this is a matter of considerable importance to the breeder, since it explains how it is that occasionally two Rex rabbits produce normal coated offspring The subject of yellow fat is discussed at some length, but in Great Britain the conclusion of Prof Castle that it is of little or no economic importance is not correct, for many firms pay a considerably lower price for carcases showing this character There are thirty nine photographs of the different types of rabbit, and of these the majority are both clear and helpful The bibliography consists of only about fourteen references

It is impossible to recommend the purchase of this book to the average British rabbit breeder, but to the few who already possess a working knowledge of Mendelism it must prove of very considerable interest The charge is often made that the geneticist finds it impossible to present that which he has to say in terms so simple that anyone may read and understand Many have tried to do this and all have failed It would seem to be far easier to discuss, in everyday language, the origin and nature of the universe than to explain the origin and genetic nature of a new coat colour in the rabbit An understanding of many new words is demanded Is it too much to hope that the breeder, being persuaded that there are financial advantages associated with the possession of a new jargon, will acquire it? F A E CREW

Our Bookshelf.

The Flora of Northamptonshire Being a Topographical and Historical Account of the Flowering Plants and Ferns found in the County, with short Biographical Notices of the Botanists who have contributed to Northamptonshire Botany during the last Three Centuries By Dr George Claridge Druce Pp cxlii + 304 (Arbroath T Buncle and Co, 1930) n p

THE veteran British botanist, Dr G C Druce, has published a flora of the county in which he was born In many respects the work is a model of what a county flora should be, and must rank with the same author's floras of Oxfordshire, Berkshire, and Buckinghamshire as a noteworthy contribution to the floristics of Great Britain

About 25,000 acres of Northamptonshire are under timber The concise account of the geology (contributed by Mr Beeby Thompson) clearly indicates the dominance of Mesozoic formations of Liassic and Oolitic ages, a fact which explains such peculiarities of the vegetation as the absence of extensive heaths The botanical divisions used by Dr Druce are conveniently based on the river drainage

An interesting feature of the book is an extensive "Botanologia", in which appear biographical accounts of all who have contributed to our knowledge of the botany of Northamptonshire Special attention is directed to those dealing with John Morton, John Hill, and John Clare These biographical notices, and especially the lengthy one on the poet Clare, are of general interest and should prove useful to historians of British botany

The flora of Northamptonshire consists of 977 species (1925 estimate), a somewhat smaller number than estimated for the surrounding counties A list of noteworthy absentees is given The county has no species peculiar to it, but a number of rarities include *Anemone Pulsatilla*, *Epilobium Lamyi*, *Zannichellia gibberosa*, and *Bromus interruptus*

The sequence and nomenclature of species in the systematic part are those of the author's "British Plant List" (second edition) Vernacular names are given and alien species are starred The "grade of citizenship the plant occupies in Northamptonshire", the habitat, the earliest known record for the county, and localities (for all but the common and generally distributed plants) are concisely indicated The listing of microspecies or varieties of *Bursa* (*Capsella*), *Rubus*, *Rosa*, *Cratægus*, *Taraxacum*, and some other genera, makes one wish that critical studies involving cultural and breeding experiments were more in favour with British field botanists

The book is well printed, of convenient format, and the proof-reading has been carefully done

W B T

A Textbook of Plant Physiology By Prof N A Maximov Translated from the Russian Edited by A E Murneek and R B Harvey (McGraw-Hill Publications in the Agricultural and Botanical Sciences) Pp xvi + 381 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1930) 20s net

THIS book has been translated into English from the Russian It is a pity that such a step should have proved necessary, for, in view of the relatively large number of universally well known plant physiologists in Great Britain, we should prefer to see such a text book written for our own universities, although it must be granted that it is difficult to conceive of an average syllabus for the subject, at present We have our own familiar books, useful, however, only to the research worker for reference, and too exhaustive to be of any value even to the honours student This probably leads to the state of affairs in the botany schools of British universities, where the student specialises at far too early a stage

Therefore this book should be welcomed if only as a possible means of stabilising the erratic subject It is written by a distinguished physiologist who himself specialises in the water relations of the plant, but he has not allowed such authority to undermine the value of his book by giving it too much prominence The book thus remains a comprehensive though introductory work to the subject of vegetable physiology The first part deals with

the absorption of matter and energy in which photosynthesis, the nitrogen cycle, and other growth factors receive adequate consideration Water relations are examined in the second part from water absorption to transpiration The third part considers the energy question in all its aspects, and growth movement and reproduction take up the fourth part

The whole work is written in an attractive style and is well illustrated All the familiar theories and hypotheses which pervade plant physiology to an inordinate degree are mentioned, but not overworked British, American, and other physiologists are given a fair hearing The excellent and well-balanced choice of material, the masterly way with which it is dealt, and the reference books and periodicals mentioned in an appendix, all make the book a splendid acquisition to plant physiological literature, and one to be recommended to students of the subject up to degree standard

Annual Reports on the Progress of Chemistry for 1930 Issued by the Chemical Society Vol 27 Pp 389 (London The Chemical Society, 1931) 10s 6d net

THE Annual Reports for 1930, issued by the Chemical Society, comprise reviews in the following fields general and physical chemistry (C N Hinshelwood), inorganic chemistry (H Bassett), organic chemistry (aliphatic, E H Farmer, homocyclic, G M Bennett and A W Chapman, heterocyclic, S G P Plant), analytical chemistry (J J Fox and B A Ellis), biochemistry (A C Chibnall and J Pryde), geochemistry (A F Hallimond), radioactivity and subatomic phenomena (A S Russell), and the electrical conductivity of solutions (Sir Harold Hartley, O Gatty, W A Macfarlane, and D M Murray-Rust)

It is customary to endeavour in these reports to present a fairly detailed picture of development in phases of the science, rather than to attempt an annual catalogue of even the more outstanding papers in every branch of pure chemistry They are, in fact, reports rather than summaries, and are in consequence both readable and instructive Thus the first chapter deals *inter alia* at some length with the quantum mechanical treatment of chemical forces, with the elementary processes of chemical change, and with chain reactions, while it intentionally leaves certain equally important matters for more profitable discussion on a future occasion

The reporter on inorganic chemistry protests with justice against the tendency towards multiple publication, whereby the journal literature is distended unnecessarily In the report on analytical chemistry, attention is directed to recent advances in the utilisation of physical methods for analytical purposes, and developments in micro-analysis are mentioned The report on subatomic phenomena and radioactivity reviews work published in 1929 and 1930, most of which has been physical in character. The main object of the report on the electrical conductivity of solutions, which deals chiefly with researches carried out between 1920 and 1930, is to show how far the Debye–Hückel theory is in accord with the results of conductivity measurements A A E

Our Catkin-bearing Plants an Introduction By H Gilbert Carter Pp xii + 61 + 17 plates (Oxford Clarendon Press, London Oxford University Press, 1930) 4s 6d net

THE object of the author in writing this book was to provide a short and concise account of the catkin-bearing trees that could easily be understood by students That he has succeeded in his endeavour is very evident to those who possess an intimate knowledge of the several families to which the term applies Although in the space at his disposal he was unable to deal with all the catkin bearing trees that are hardy in the British Isles, his selection of representatives for each family is such that students should have little difficulty in finding living examples either wild or in parks or gardens In his preface, Mr Gilbert-Carter is very careful to point out the urgent need for students of botany acquiring a knowledge of living plants by studying them as they grow, instead of contenting themselves with the examination of specimens in the classroom, and that advice cannot be too strongly emphasised Mr Gilbert Carter's descriptions of willows, poplars, elms, birches, oaks, walnuts, and other trees are excellent in every way They all appear in easily understood language, and on each page there are explanatory footnotes of the scientific terms used A number of excellent photographs add to the value of the work, which will be found very useful to both teachers and students

About Science a Book for the use of Senior Science Students and those who are going to teach Science By Dr B Millard Griffiths Pp v + 142 (London John Murray, 1931) 3s 6d

DR GRIFFITHS has written a pertinent little book, and one which ought to interest educationists and students alike The unassuming title of the work makes it plain that the author had no intention of giving a complete survey of scientific method, though many of his arguments are framed in an original and persuasive way In his introduction, Dr Griffiths very rightly complains that students of science are told little or nothing about the foundations upon which science stands, because the foundations of knowledge form a part of philosophy, and he maintains, with equal reason, that such an omission is a handicap for them in life, because it makes it difficult for them to appreciate the relationship of science to literature, history, and art, which are important things in life So his book is written mainly for the purpose of interesting science students in the more philosophical aspects of science We wish him success in his attempt But we would go further, and suggest that students would have everything to gain and nothing to lose if their science curricula were less crowded, and if they were given in exchange an introductory course in mental orientation and the methods of knowledge T G

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Mouth-Posture Forms of Phœnician Cuneiform Symbols

By the courtesy of M. Virolleaud, the decipherer of the recently discovered Phœnician cuneiform alphabet of Ras Shamra, I have had the opportunity of studying the twenty nine symbols (including alternatives) which he has identified, and the phonetic values which he attributes to them. It is therefore possible to compare the form of the symbols with that of the mouth posture (or gesture) which produced the sound for which it is believed, they each stood. The symbols and their phonetic values and Hebrew equivalents are set out in Fig. 1.

Of the twenty nine symbols, almost every one is suggestive (more or less) of the mouth posture or gesture (for a mouth facing to the left) which produces the sound symbolised. Thus, of the four vowel symbols, that for a (see Fig. 2) represents a flat tongue posture, those for e, é, and i are consistent with progressively higher postures – the middle stroke of the E like symbol being symbolic of the tongue at mid height. Compare the successive cross strokes—corresponding with successive elevations of the tongue posture—in the Ogam vowel symbols, Fig. 2. The comparison of the symbols for é and e with the later symbol E may be noted. There is no symbol for o or u, but the symbol for w is quite suggestive of two protruded lips. Of the symbols for the other bilabial sounds – p, b, m, and ph—p is obviously apposite, b is a double closure, m (two strokes forming a right angle) may symbolise a lip closure, but is not consistent with the p and b symbols. The three primary vertical closures—namely, (voiced) g, tongue to soft palate, d, tongue to hard palate, and b lip to lip—are represented by comparable vertical symbols, of which the bilabial b has monopolised the two stroke symbol.

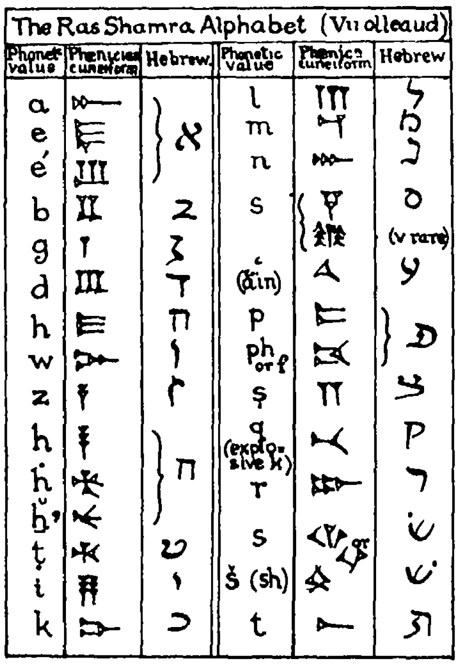

FIG. 1.

The corresponding (so called) unvoiced consonants, k, t, p, though anomalous in that the strokes are horizontal instead of vertical, are consistent with one another. Compare also the triple headed sign for the enduring n with the single head of the momentary t sound. It will be seen that the symbol for n is also closely related to that for d, which is due to a similar tongue posture. The symbol for k may be compared with the funnel shaped symbol for 'ain—both formed by a (more or less) constricted throat. Of the other consonants due to an elevated tongue posture, l is consistent, so are two at least of the different varieties of s (samekh and tsade) and the z sign (zayin). The rare form of samekh may represent the tongue *between* the upper and lower teeth.

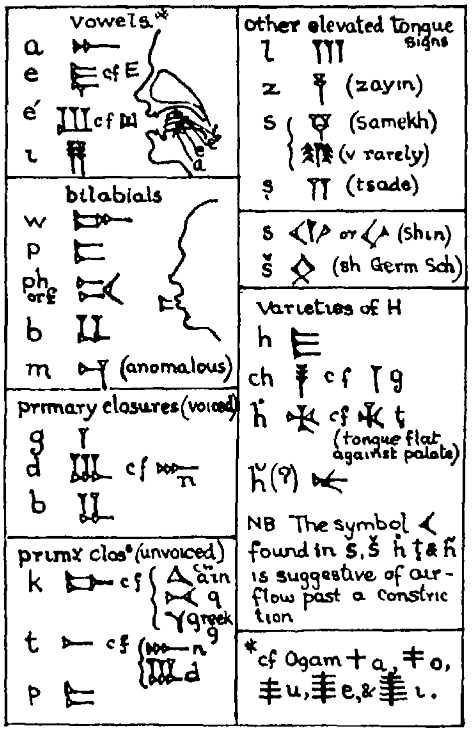

FIG. 2.

There only remain the h sounds, and a ⊰ type of symbol found in the letters h (strongly aspirated in the lower throat), h̆ (?), ṭ (flat tongue against palate), ph or f, q (explosive k), s (shin) and š (German sch), and in the symbol for r. The h symbol (three parallel horizontal strokes) is not inapposite to an air flow through the mouth. The three headed sign for cheth (ch as in German buch) is appropriate for the prolonged sound due to an incomplete g closure—the symbolism of single and triple heads for sudden or prolonged sounds being similar to that already found in t and n, and perhaps also in r. The ⊰ sign seems to represent an air flow through a constriction, since all the symbols which contain it (h, h̆ (?), ṭ, ph, q, s, and š) have this characteristic.

The dawning mouth symbolism which I pointed as appearing in Sumerian cuneiform, in a paper (British Association, Sept. 8, 1930) before the publication of the Ras Shamra alphabet, is substantially confirmed by M. Virolleaud's interpretation of it.

Some examples, taken from that paper, are shown in Fig. 3.

In conclusion, I would emphasise that it is not suggested that the scribe who selected the mouth like cuneiform symbols, whether syllabic or alphabetic, was at all conscious that what he was doing had

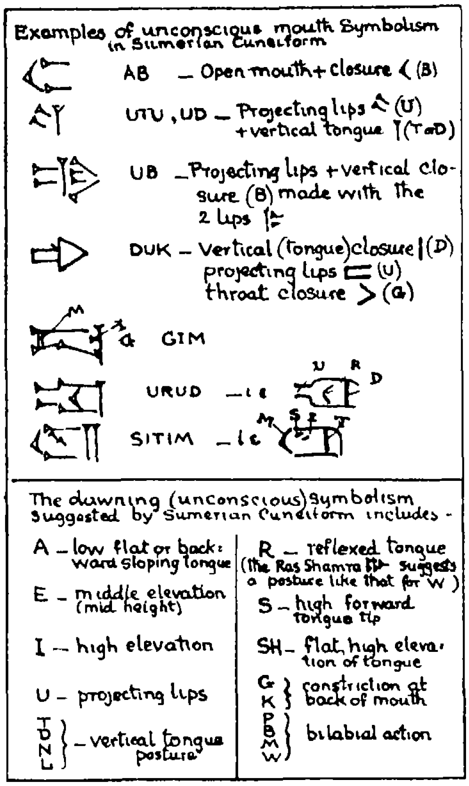

FIG 3

any relation to his own mouth gestures. What I do suggest is that, in choosing a symbol for a given sound he was unconsciously biased in favour of a type of symbol in the making of which his hand followed a track comparable with that which his mouth, tongue, or lips followed in pronouncing the sound of the symbol in question.

R. A. S. PAGET.

1 Devonshire Terrace,
Lancaster Gate, W 2,
April 24.

Mortality among Plants and its Bearing on Natural Selection

I HAVE followed with considerable interest the recent communications in NATURE of Prof. Salisbury,[14] Prof. Haldane,[1] and Prof. MacBride[2] in connexion with the important matter of mortality among plants and its possible bearing on natural selection.

Prof. Salisbury hopes that other investigators may be induced to record their experiences regarding mortality in young plants, so that it may be possible to judge how general is the phenomenon under consideration. For this reason I refer interested readers to details published by me,[3 13] regarding the mortality in flowers, fruits, young regeneration, and in semi mature, mature, and over mature individuals of certain South African forest species—details based upon investigations carried out during the period 1922-27. Close observation of a systematic nature over a wide area, transect, quadrat, and cultural studies, and instrumental analysis of habitat factors were employed, hence it can be claimed that the data relating to the Knysna forests were collected critically. Furthermore, since 1927 it has been possible to make certain more general observations in subtropical evergreen forest and in savanna vegetation in East Africa; these, while much less critical, in general, support my findings at Knysna.

In the space available I cannot enter into any details, but would refer those interested to the original papers. It is, however, possible to summarise briefly the general nature of the results.

(1) In the species studied—*Podocarpus falcatus* R. Br., *P. latifolius* R. Br., *Olea laurifolia* Lamk., *Platylophus trifoliatus* Don, *Cunonia capensis* L., *Ocotea bullata* E. Mey., *Olinia cymosa* Thunb., *Faurea McNaughtonii* Phill., *Myrsine melanophleos* R. Br., *Apodytes dimidiata* E. Mey., *Gonioma Kamassi* E. Mey., *Virgilia capensis* Lamk.—mortality was found to be greatest in the flowers, fruits, and young regeneration.

(2) Mortality in older stage regeneration, in saplings, poles, large immature and mature trees, in proportion was much less.

Mortality due to insect and fungus ravages was low in all species investigated, except *Olea laurifolia* and *Virgilia capensis*. In *Olea*—a genus taking probably 200-400 years to attain full dimensions, and possessed of a very hard, small pored, heavy timber—mortality due to *Fomes applanatus* (Pers.) Gill, *F. rimosus* Fr., and *Stereum hirsutum* Fr. is high, infected trees being broken above ground by windstorms; in addition, owing to its heavy, large crown and flat root system, this species is wind thrown in large numbers.

In *Virgilia*, the caterpillar of the Silver moth and parasitic *Cassytha* and *Cuscuta* cause premature death in large numbers.

(3) Considering the host of biotic foes and the physical factors working against the production of regeneration in such species as *Olinia cymosa, Platylophus, Cunonia, Ocotea*, and *Faurea McNaughtonii*, it is somewhat remarkable that there is *any* regeneration resulting from *seed*; undoubtedly all these, except *Faurea*, are assisted in holding ground by the fact that they produce abundant, vigorous coppice.

(4) A careful investigation of the principal biological features of sixty three of the more important tree and shrub species of the Knysna,[7] together with the ecological conditions of the communities in which these species grow, shows the following factors to be the prime ones responsible for high mortality:

(i.) Inherent low degree of fertility in flowers and fruits; (ii.) defeat in competition for pollination; (iii.) irregular occurrence of flowering and fruiting seasons (some flower crops produce few or no fruits); (iv.) low capacity of germules for lying dormant—young growth often is produced at uncongenial periods, climatic, edaphic, and biotic; conversely, germules of high dormant capacity are subjected to depredations of various enemies; (v.) unsuitable aerial and edaphic conditions, these acting against efficient germination and establishment; (vi.) insects and fungi attacking flowers, fruits, and (vii.) birds and mammals feeding on flowers, fruits, and seeds, and mammals browsing young regeneration; (viii.) certain strong reactions of *biotic* communities upon habitat factors, principal among these being reactions upon light intensity, soil moisture content, and *water supplying power* of the soil (as measured by Livingstone soil-points).

(5) In the East African savannas, mortality in young stages is due not only to large numbers of termites, rodents, and ungulates, but also largely to seasonal or periodic fires that sweep through great stretches of the country.[12] There is, for example, enormous

mortality in the seedlings of the great genera *Brachystegia* (and *Berlinia*), *Acacia*, *Combretum*, *Terminalia*, and *Commiphora*, while loss in first stage seedling Gramineæ is extremely great in proportion to the numbers produced

(6) Obviously, mortality factors definitely must influence the general distribution of a species—favouring one, hindering another, and through these reactions automatically favouring or hindering yet other species

Any careful student working at the ecology of natural communities should be able to adduce data of similar kind

I have little hesitation in agreeing with Prof Salisbury that the actual selection among the progeny of individuals seems to take place *largely* in those phases of development showing the *least* divergence morphologically—*the young regeneration stages* At the same time, I maintain that we must not lose sight of the mortality rates in the flowering and fruiting phases of older plants this point Prof Salisbury, of course, has taken into account

It might not be without interest to record that, unknown to himself, Prof Salisbury actually was the person who inspired me with a desire to investigate the mortality factors in African vegetation—through the medium of a remark in a letter in 1922 "One is almost accused of having a morbid mind if one emphasises the need for investigation of the factors responsible for mortality in plants"

So much for mortality in plants Observations made by me since 1922 upon various invertebrate and vertebrate groups in *biotic* communities show that among animals the mortality in the young stages is often extremely great From general impressions gained in South and East Africa I feel that a statistical study of the mortality rate in infants and younger children, among primitive peoples, too, would support the view that it is in the earlier stages that there is the greatest proportional mortality, apart, of course, from the actually senile classes JOHN PHILLIPS

Kondoa Irangi,
Tanganyika Territory,
Mar 1

[1] Haldane J B S, NATURE, **126**, 883, Dec 6, 1930
[2] MacBride, E W, NATURE, **127**, 55, Jan 10 1931
[3] Phillips, J F V, *S African Jour Nat Hist*, **4** (3) 209-220 1923
[4] Phillips, J F V, *S African Jour Sci* **21**, 275 292, 1924
[5] Phillips, J F V, *idem*, **22** 144 160 1925
[6] Phillips J F V, *Ecology* (American), **7** (3) 338 350, 1926
[7] Phillips J F V, *S African Jour Sci* **23** 366-417 1926 *
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[9] Phillips, J F V, *Trans Roy Soc S Africa*, **14** (4), 317 336, 1927
[10] Phillips J F V, *Ecology* **8** (4) 435 444 1927 *
[11] Phillips J F V, *Trans Roy Soc S Africa*, **16** (2), 162 190, 1928
[12] Phillips J F V *S African Jour Sci*, **27**, 352 367, 1930
[13] Phillips J F V *Bot Survey Union S Africa*, 1931, in press *
[14] Salisbury F J, NATURE, **125**, 817, May 31, 1930

* Contain fuller data

Thrips tabaci Lind as a Vector of Plant Virus Disease

Two years ago, there was discovered in a commercial glasshouse in Cardiff a plant of *Solanum capsicastrum* which was affected with a virus disease in which the symptoms consisted of numerous concentric circles on the leaves This virus has been investigated at Cambridge, it has been transmitted by artificial means to various hosts, including the tobacco plant, on which it produces a typical ringspot disease [1]

Further studies have been carried out upon the insect vectors of this ringspot and, out of a number of insects tested, one, *Thrips tabaci* Lind (Morison det) has proved itself a most efficient vector of the virus (Fig 1) This is the first record of plant virus transmission by Thrips in the British Isles

Recently I received from the neighbourhood of Cardiff some tomato plants also affected with a virus Experiments carried out upon these plants showed

FIG 1—A tobacco plant infected with ringspot by *Thrips tabaci* Note the concentric rings, surrounded by a halo, developing close to the feeding marks of the insect, which appear as whitish dots

them to be infected with a very serious virus disease known in Australia as 'spotted wilt' The disease is transmitted in that country by the Thrips, *Frankliniella insularis* Frankl [2] The symptoms of spotted wilt on tomato consist of bronzing of the young leaves,

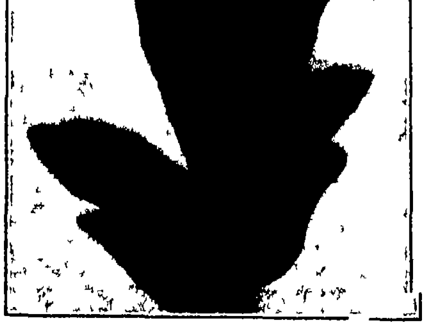

FIG 2—Tomato leaf showing one of the symptoms of spotted wilt, in this case ring like markings on the leaves

the development of ring like markings on leaves and fruit (Fig 2), and cessation of growth—occasionally the plant is killed Experiments at Cambridge have shown that *Thrips tabaci* transmits this virus also

The similarity in the mode of transmission between spotted wilt of tomato and the *S capsicastrum* and

tobacco ringspot, together with certain other factors, suggested the possibility that the two viruses might be the same. A comparative study of the host range and symptom expression on differential hosts of the respective viruses offers almost conclusive evidence that both diseases are due to the same entity. There seems, also, to be little doubt that the dahlia plant acts as another host for the virus. Dahlias affected with a virus disease, which expresses itself in concentric circles on the leaves (Fig 3), occur commonly in the neighbourhood of tomatoes infected with spotted wilt. Inoculation from such dahlias to tobacco and *Datura* produces symptoms indistinguishable from those produced in tobacco and *Datura* by spotted wilt and the *S capsicastrum* ringspot.

FIG 3 —Leaf of dahlia infected with the ringspot virus

The insect vector of tobacco ringspot as it occurs naturally in the tobacco fields of America and elsewhere does not appear to be known. In the light of these new facts, it is worth while to suggest that here also the insect vector may be a species of Thrips, whether there is any connexion between the tobacco ringspot of America and tomato spotted wilt which has recently been discovered there,[3] is still to be proved.

As spotted wilt is a disease of great economic importance in Australia, this announcement of its appearance in the British Isles is of some moment. The Thrips which transmits the virus in England occurs very commonly in glasshouses but, owing to its minute size, is easily overlooked. Its presence can, however, be recognised by the feeding marks of the insect, which consist of silvery white patches on the leaves accompanied by minute granules of excreta. Without in any way wishing to be an alarmist, I would suggest that tomato growers should be on the look-out for the appearance of spotted wilt in their glasshouses.

I have pleasure in acknowledging my indebtedness to Mr John Rees, Adviser in Agricultural Botany, University College, Cardiff, who sent me the affected plants.

KENNETH M SMITH
Potato Virus Research Institute,
School of Agriculture,
University of Cambridge, May 16

[1] Smith, Kenneth M, *Ann Appl Biol*, 18, No 1
[2] Samuel, G, Bald, J G, and Pittman H A, *Bull* 44, Coun Sci Indust Res Australia
[3] Doolittle, S P, and Sumner, C B, *Phytopath*, 21, No 1

The Photosensitised Explosion of Hydrogen-Oxygen Mixtures in the Presence of Chlorine

A RESULT of some interest has recently been obtained relative to the explosion of hydrogen and oxygen by the photosensitising action of chlorine in light from the mercury vapour lamp transmitted by glass. The experiments were initially carried out at a temperature of about 300° C with the view of testing the possibility of the initiation of a hydrogen-oxygen chain mechanism by the hydrogen atoms produced in the hydrogen chloride synthesis. When 280 mm of a mixture ($2H_2 + O_2$) was exposed in a cylindrical glass reaction vessel to light from a mercury lamp, no effect was observed. If chlorine in increasing quantities was added, a sharp limit of chlorine pressure was found, above which a practically instantaneous and quantitatively complete explosion of the hydrogen and oxygen to form water occurred. Below this limit a rapid reaction between the hydrogen and chlorine occurred, which was complete in a few minutes, only a trace of water formation, if any, being observable. The limit of chlorine pressure was exceedingly sharp and could be fixed with precision to one or two mm. In the particular apparatus used it was 135 mm at 300° C. The experiments were then carried out at other temperatures, the quantity of hydrogen oxygen mixture always being adjusted to a constant molar concentration in the reaction bulb. It was found, contrary to initial expectation, that the hydrogen-oxygen explosion could be sensitised down to room temperature, though a much greater chlorine pressure was required at this lower temperature. In the accompanying graph (Fig 1) is plotted the limiting

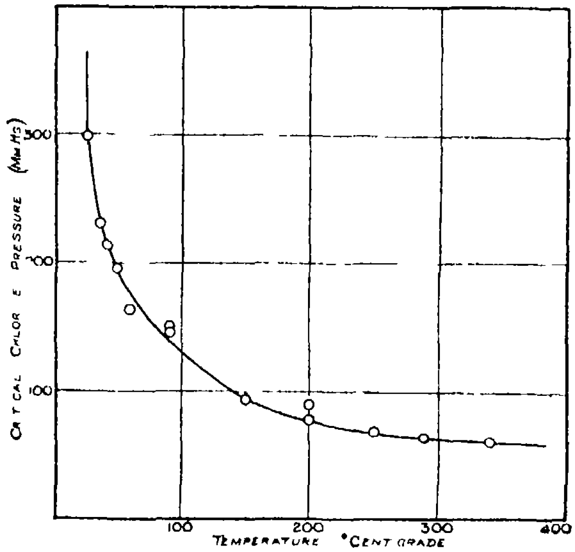

FIG 1

chlorine pressure, reduced to 0° C, required to sensitise the explosion of ($2H_2 + O_2$) at constant molar concentration corresponding to a total pressure of 156 mm at 0° C.

At constant temperature, the limiting chlorine pressure is, roughly, directly proportional to the total pressure of the system, but variation of the hydrogen-oxygen ratio does not markedly affect the limit.

The explosions at the higher temperatures were sharp but not violent, and nearly quantitative. At the lower temperatures they were never complete, and often seemed to partake of the character of a violent detonation.

It is clear that the photosensitising function of the chlorine cannot be solely attributed to the initiation of reaction centres for the hydrogen oxygen reaction. These, in any case, would be incapable of projecting reaction chains at low temperature. More probably its function is twofold. We may suppose that in the first instant of illumination there is a rapid reaction of hydrogen with chlorine, and that some small element of the system is adiabatically raised to the explosion temperature of hydrogen and oxygen. The hydrogen atoms of the hydrogen-chlorine chains then form plentiful starting points for the hydrogen-oxygen chains, and the combination of hydrogen and oxygen spreads out from this point by flame propagation.

This view is borne out by the fact that at a given temperature the explosion always appeared to be connected with a Draper effect (pressure increase), of

limiting magnitude in the mixtures with just less than the critical chlorine pressure Further, while the explosion was more usually apparently instantaneous on admitting the light, there was sometimes a delay of about one second in mixtures close to the limit, when a Draper effect of similar magnitude was observable

A more detailed account of this reaction and a theory of the kinetic mechanism will appear at an early date

R G W NORRISH

University Chemical Laboratory,
Cambridge, April 29

Photochemical Interactions of Hydrogen with Chlorine and Bromine

THE photochemical interaction of chlorine and hydrogen has been recently described as an inexhaustible theme Despite the fact that it has been the subject of so many carefully performed experimental researches, it is not yet possible to describe the stages of transformation of the two gaseous elements into the compound hydrogen chloride We have recently solved one of the outstanding difficulties The rate of union of the corresponding reaction between hydrogen and bromine is nearly proportional to the square root of the intensity of the light, that is, to the light absorbed by the bromine in unit time, whereas determinations of the rate of union of chlorine and hydrogen have shown it to be almost directly proportional to the intensity of the light

This marked difference in behaviour we have shown to be due to the fact that the determinations of the rates of reaction with hydrogen and bromine have been made in the absence of impurities which inhibit the reaction, whilst those with hydrogen and chlorine have been made with mixtures which contain such impurities, notably oxygen Our recent experiments show that if the chlorine used in the experiment is separated from the inhibitive impurity, oxygen, by fractional distillation, and then afterwards purified from other inhibitive impurities by washing it with pure water the rate of reaction in question is, like that of the reaction between hydrogen and bromine, no longer directly proportional to the intensity of the light, but more nearly to its square root Moreover, it was shown in this laboratory by E R Boller, almost two years ago, that if a mixture of hydrogen and bromine contains a very small quantity of nitric oxide—an impurity which had previously been shown to be a powerful inhibitor—the rate of formation of hydrogen bromide became proportional to the intensity of the light Therefore, so far as the influence of the light is concerned, these two analogous photochemical changes show the expected correspondence

D L CHAPMAN
F B GIBBS

Leoline Jenkins Laboratories,
Jesus College, Oxford,
May 9

Optical Activity dependent on Co-ordinated Nickel

IN continuation of our researches on co ordination compounds containing $\alpha\alpha'$-dipyridyl (dipy) we have prepared the following pink complex nickelous salts the chloride $[Ni\ 3dipy]Cl_2,\ 6H_2O$, the corresponding hexahydrated bromide, iodide, and nitrate, and the thiocyanate $[Ni\ 3dipy](CNS)_2,\ 3H_2O$

From the chloride and ammonium *d*-tartrate was obtained a readily soluble dextrorotatory tartrate, $[Ni\ 3dipy]C_4H_4O_6,\ 6H_2O$, which on double decomposition with ammonium chloride furnished an optically active tris $\alpha\alpha'$ dipyridyl nickelous chloride When viewed in the polarimeter illuminated by a mercury arc using the yellow line, a 0 5 per cent aqueous solution of this chloride in a 2 d cm tube gave a maximum rotation of +5 5° which at 20° decreased to +0 08° in one hour The rate of diminution of optical activity between these limits was that required for a unimolecular reaction The maximum activity corresponds with a specific rotation $[\alpha]$ +550° and with a molecular rotation $[M]$ +3877°

Analogous complex salts have been obtained with bivalent manganese and similar cobaltous compounds are under examination

The $\alpha\alpha'$-dipyridyl required for these experiments was obtained by Hein and Retter's method of dehydrogenating pyridine with ferric chloride under pressure, and in this preparation we have so far isolated some ten additional products, including a tripyridyl (tripy) which gives rise to well defined co ordination compounds with bivalent iron and nickel of the general type $[M\ 2tripy]X_2$

G T MORGAN
F H BURSTALL

Chemical Research Laboratory,
Teddington, Middlesex,
May 16

Emission Bands in the Mercury Spectrum under Low Excitation

IN a letter published under the above title in NATURE of May 2, it was stated that the series of bands which appear in absorption of the unexcited vapour in the region from λ2943 to λ2614 could be obtained in fluorescent emission by exciting with the iron arc in the region on the long wave side of the resonance line λ2537 It is not necessary to excite close to the resonance line in order to get them This band series accordingly forms part of what I have called the 'wing effect'

A further very definite result is now to be communicated The 'core effect', that is, the fluorescence obtained when stimulation is by the exact wave length of the atomic resonance line as given by a cooled mercury lamp, also includes a band series in the same region of the spectrum, but it is not identical with, or, so far as can be seen at present, definitely related to, the previous band series forming part of the wing effect

It is identical with the series which I formerly measured in electrically stimulated vapour [1] I then called it the emission series of the less refrangible region, to distinguish it from the other series in the same region which had only been obtained in absorption of the unexcited vapour These names are no longer distinctive, and I shall speak for the present, and quite provisionally, of the core series and the wing series, according to the mode of excitation in fluorescence

The wing series is related to the apparently continuous maximum around λ3300 at its tail end by the fact that both are greatly enhanced by superheating the vapour

The core series, on the other hand, seems to be related to the apparently continuous maximum around 2650 at its head, which latter forms part of the core effect, but not of the wing effect Neither the core series nor the maximum 2650 at its head are at all enhanced by superheating

These various relations come out very strongly in the photographs, which it is hoped to reproduce, and which will make them clearer than a short written account can be expected to do

RAYLEIGH

Terling Place,
Chelmsford, Essex,
May 25

[1] *Proc Roy Soc*, A, vol 116, p. 703, 1927

Fine Structure in the Arc Spectra of Bromine and Iodine.

Bromine.—The fine structures of a number of bromine arc lines have been previously reported by Hori [1]. By assuming that the lines λλ6632, 6560, 6351, 6149 have identical structures, De Bruin [2] inferred that the nuclear spin is $\frac{3}{2}$. The fine structure measurements have been considerably extended, using a high frequency (15 megacycles) electrodeless discharge in pure bromine vapour and a Fabry Perot interferometer. All the observed structures arise from the $4p^4 5s$ electron configuration, as was to be expected. Although the lines employed by De Bruin have not identical structures, as he supposed, the value of $i = \frac{3}{2}$ has been confirmed. There is evidence that the two isotopes of bromine (79, 81) have the same nuclear spin.

Iodine.—Fine structures have been previously recorded only in the iodine spark lines,[3] but by employing similar experimental arrangements to those used for bromine, fine structures have been observed in the region λ4700–λ8000. The arc lines are mostly regular quartets and sextets degrading to the violet in both intensity and interval. The simple regularity of the structures is such that they are obviously characteristic of only one j term in each line. The observed structures arise from the $5p^4 6s$ electron configuration, that is, that corresponding to the $4p^4 5s$ in bromine. This is in agreement with the partial analysis of the spectrum made here by S. F. Evans (unpublished). As $2i + 1$ is the maximum multiplicity attainable, the existence of sextet terms proves that i is at least equal to $\frac{5}{2}$, which had been previously inferred from the absence of appreciable alternating intensities in the absorption band lines of I_2.

Since with j less than i the full multiplicity is not attained, the application of the interval rule must decide the value of i (in the absence of Zeeman effect measurements). The best line observed is λ4862, which is a quartet and this involves $j = \frac{3}{2}$ in the $5p^4 6s$ term (this is confirmed by the analysis). The intervals are 123, 103, 83 (cm$^{-1} \times 10^{-3}$), that is, 6×20.5, 5×20.6, 4×20.7. A value of $i = \frac{9}{2}$ must be invoked to fit these exact ratios (6 : 5 : 4), and this value is supported by the interval ratios in other lines.

The most probable values of i for the halogens are shown in the table below.

Halogen	Fluorine	Chlorine	Bromine	Iodine
Number of Protons	19	35 (37 39)	79 81	127
Nuclear Spin	$\frac{1}{2}$	$\frac{5}{2}$	$\frac{3}{2}$	$\frac{9}{2}$

No apparent regularity exists, but the large and small i values are associated with a single isotope. Full details of the fine structure measurements will be published elsewhere.

S. TOLANSKY.

Physics Department, Armstrong College
(Newcastle on Tyne),
Durham University, May 5.

[1] Hori, *Mem. Coll. Sci. Kyoto*, vol. 9, p. 307, 1926.
[2] De Bruin, NATURE, Mar. 15, 1930, vol. 125, p. 414.
[3] Wood and Kimura, *Astroph. Jour.*, vol. 46, p. 181, 1917.

The Resonance Potential of Trebly Ionised Bismuth

USING the known data of the spectra Hg I,[1] Tl II,[2] and Pb III,[3] and extrapolating by means of the irregular doublet law, the predicted values of the wave numbers of the important combinations $6s6s\ {}^1S_0 - 6s6p\ {}^3P_1$ and $6s6s\ {}^1S_0 - 6s6p\ {}^1P_1$ of Bi IV are approximately 76,000 and 115,000.

In a list of wave-length measurements of the vacuum spark of bismuth in the Schumann region, for which I am indebted to Dr. R. J. Lang, there are very strong lines at 75923 (λ1317.12 A.) and 114601 (λ872.59 A.). If these are assumed to be the above-mentioned combinations, then $6s6p\ {}^3P_1 - 6s6p\ {}^1P_1$ would be 38678. A distinctive feature of the spectra Hg I, Tl II, and Pb III is the appearance with great intensity of lines arising from intercombinations between singlet and triplet terms. One would therefore expect to find the wave number difference 38678 recurring a number of times in the Schumann region. At least five pairs of lines with this difference have been found in approximately the expected positions. However, in spite of this apparent corroboration, I have been somewhat doubtful of the validity of the foregoing identification, because the line 75923 had already been included by Lang[4] in a scheme for Bi III. In a recent paper[5] by McLennan, McLay, and Crawford on the spark spectra of bismuth, the line 75923 finds no place in the scheme for Bi II or for Bi III.

Still more significant evidence that this line belongs to Bi IV, and is in fact the resonance line $6s6s\ {}^1S_0 - 6s6p\ {}^3P_1$, is to be found in the data given by Arvidsson[6] in a recent letter to NATURE, in which it is reported that the line 75923 has been resolved into three components of relative intensities 6 : 5 : 5. If it is assumed that the nuclear quantum number of bismuth is 9/2 and that the $6s6s\ {}^1S_0$ term is single, then the theoretical relative intensities of the three components of the $6s6s\ {}^1S_0 - 6s6p\ {}^3P_1$ combination as calculated by the formulæ given by Pauling and Goudsmit[7] is 6 : 5 : 4 in order of decreasing wave number. This agrees very closely with the experimental ratio. It therefore seems very probable that this is the resonance line of Bi IV, giving the value 9.36 volts for the resonance potential.

Some progress has been made in finding further wave number regularities in Bi IV, but the spectrum is difficult to interpret because of the j, j coupling of the two electrons. The work is still proceeding and it is hoped that a detailed report will be made elsewhere at a later date.

STANLEY SMITH.

University of Alberta,
Edmonton, Canada,
April 10.

[1] Fowler, A., "Series in Line Spectra," p. 148. Fleetway Press (1922).
[2] McLennan, J. C., McLay, A. B., Crawford, M. F., *Trans. Roy. Soc., Canada*, 22, p. 241, 1928. Smith, S., *Proc. Nat. Acad. Sci.*, 14, p. 951, 1928.
[3] Rao, K. R., Narayan, A. L., Rao, A. S., *Indian Jour. Phys.*, 2, p. 467, 1928. Smith, S., *Proc. Nat. Acad. Sci.*, 14, p. 878, 1928.
[4] Lang, R. J., *Phys. Rev.*, 32, p. 737, 1928.
[5] McLennan, J. C., McLay, A. B., Crawford, M. F., *Proc. Roy. Soc.*, A, 129, p. 579, 1930.
[6] Arvidsson, G., NATURE, 126, p. 566, 1930.
[7] Pauling, L., and Goudsmit, S., "Structure of Line Spectra," p. 140 and p. 214. McGraw Hill (1930).

Impact Figures on Polished Rock Salt Surfaces

IF a small steel ball is dropped from a height of a few inches on a polished rock salt surface, the imprint of the ball on the crystal surface remains as a circular depression of one or two millimetres in diameter. The surface is deformed, however, over a region many times the area of the circular depression. If an optical test plane (a piece of ordinary plate glass will do) is placed on the crystal and the surface examined in monochromatic light, the interference pattern shows a number of families of 'loops' extending away from the imprint of the ball.

If the crystal surface approximates a 1, 0, 0 plane, the depression will be surrounded by eight sets of

loops, as shown in Fig 1 A 1, 1, 0 plane also shows an eight 'looped' figure, but in this case the pattern is no longer symmetrical but appears as Fig 1 would appear if the page was stretched to $\sqrt{2}$ of its present width This, as well as the fact that a 1, 1, 1 plane shows a six 'looped' figure, is to be expected from the atomic spacing in these planes

Fig 1

The loops, of course, are simply contours either of depressions or of elevations of the crystal surface In Fig 1, the borders are parallel to the sides of the elementary crystal cube, in this case, families of loops having axes parallel to the sides of the cube represent depressions, while those with axes parallel to the diagonals represent elevations

Sinclair Smith
Mount Wilson Observatory,
Pasadena, California,
April 23

Photographic Effects of Vitamins A and B

The biological effect of vitamins is well known, but their chemical nature is most elusive We have recently been investigating their physical effects, and some results obtained may be of interest

Photographic plates were covered with aluminium foil and letters were cut out of the foil covering the glass side Extracts of vitamins A and B, biologically tested, were used to paint the letters VA and VB on the glass side The vitamin A used was ether extract of dried ox liver, the solvent being removed in nitrogen Vitamin B was water extract of purified brewers' yeast The plates, wrapped in black paper, were left for three days, on development, clear images of the letters were obtained

To confirm the results, vitamins A and B were sealed in two separate glass tubes, and the experiment was repeated Very sharp images were again obtained

An extract of vitamin A prepared in a Paris research laboratory was investigated in the same way. It also gave positive results

Vitamins destroyed but not carbonised did not affect the plates

Two solutions, one ten times stronger than the other, of vitamin A in paraffin oil and vitamin B in water, were compared The plates showed clearly difference in strength Control experiments of pure solvents gave unfogged plates

It is interesting to note that the effect of vitamin B is similar to that of vitamin A, although the two vitamins are of different origin.

The experiments were repeated several times, and the same definite effect was present We are proceeding with our research into these effects

Sophie Botcharsky.
London

Anna Foehringer.
Laboratoire d'Électrochimie,
École des Hautes Études, Paris

Isomeric Thiosulphuric Acids.

In continuation of an investigation of thiosulphatocobalt complexes,[1] it has been found possible to isolate two very interesting isomeric modifications of thiosulphato penta cyano cobaltic acid $H_4[(CN)_5\ Co\ S_2O_3]$, the difference between which lies in the constitution of the thiosulphate radical The two acids differ in their chemical behaviour and form two corresponding series of crystalline isomeric salts Both the complex acids hydrolyse in warm water, liberating two different varieties of free thiosulphuric acid One of the latter decomposes as usual into sulphur dioxide and sulphur, whereas the other gives rise to sulphuretted hydrogen and sulphuric acid This furnishes a positive and direct evidence of the existence of two isomeric forms of thiosulphuric acid, and has indeed led to their isolation in solution The two different ways in which the constitution of thiosulphuric acid has been represented in many text books correspond, therefore, in reality to these two isomeric forms In fact, Piccard and Thomas[2] obtained an indication of the synthesis of thiosulphuric acid from sulphur trioxide and hydrogen sulphide

The constitution of the two forms is best represented by the well known formulæ

$$S{=}SO\genfrac{}{}{0pt}{}{\diagup OH}{\diagdown OH} \quad \text{and} \quad O_2S\genfrac{}{}{0pt}{}{\diagup OH}{\diagdown SH}$$

Priyadaranjan Rây
University College of Science,
Calcutta, April 15

[1] Rây, *Jour Ind Chem Soc* 4 64, 326, 1927
[2] *Helv Chim Acta* 6 1032, 1923

Ravens Flying Upside-down.

In Nature of Dec 20, 1930, p 956, Mr Sydney Evershed has described an observation relating to ravens flying upside down From this note one gets the impression that the habit is rather rare, from my observations, however, this is not the case For some years I have had the opportunity of seeing many hundreds of these interesting birds in Iceland, where the number of individuals of this species apparently is rapidly increasing, probably because the refuse from the fisheries affords food for very large numbers of them In some places—as Westmannaeyer and Hnifsdal in Isafjord—I have seen about a hundred of these birds performing evolutions in the air round favourite resting places, and here it is a rather common appearance to see the birds flying upside-down in the manner described, though I do not think I have seen them flying for so long a distance as 1000 metres, as recorded by Mr Evershed The upside-down flight is, so far as I can judge, not particularly connected with the courtship, though it is most often seen at the time of courtship, when air acrobatics are especially performed by the birds

Å Vedel Tåning
Copenhagen,
May 4.

Photosynthesis and Solution in Formation of Coral Reefs.*

By Prof J STANLEY GARDINER, F R S

THE penetrating writers on coral reefs such as Chamisso, Darwin, Dana, Semper, L and A Agassiz, Murray, and, perhaps, Wharton could scarcely be labelled as belonging to any particular science in a modern sense In contrast, the investigator of the coral reef problem ' to day is usually either a geologist or a zoologist, for the botanist has not understood, up to the present, that he may claim an equal partnership Unfortunately, the geologist rarely has sufficient knowledge of biology, although well acquainted, perhaps, with the shapes of organisms and the possibilities of earth movements The biologist, on the other hand, has views as to the disappearance of Gondwanaland , but his writings indicate his incredulity as to any suggested existence of similar earth fluctuations to day The mobile crust of the earth allows of movements in the earth's surface , but these are more often supposed to be activated by chemical processes in the inner material than by alterations in the land and sea above In addition, there are the physical and chemical reactions of the water of the ocean, and the possibilities of these, little understood even to day are almost unconsidered

I claim that there are two primarily biological forces found together on all coral reefs and assisting to shape them Photosynthesis gives an extraordinary biological efficiency to the reef building organism and, as a result, causes an incredible rapidity of formation of limestone and thus of reef growth This is countered by the solution of limestone by boring organisms, superficially appearing small in itself, but actually a main factor in that fight between death and life that is visible on every reef

The photosynthetic method of carbon feeding in most plants, depending on their chlorophyll, is too well known to require further reference There are many halophilous phanerogams which hold the sand of surface reefs together and thus add materially to their permanency Bare rock surfaces are covered by about forty species of low growing, mostly blue green algæ that prevent their destruction

A few seaweeds such as *Halimeda*, with precipitated lime in their fronds, assist in forming deposits in the sea and may even be the chief material filling up parts of lagoons But the main reef builders are about twelve species of five genera of Lithothamnioneæ, which possess dense skeletons of lime in the composition of which magnesia up to about 20 per cent may play a part Only a thin surface film is living, the light being unable to penetrate deeply through cells which are ever depositing lime in their walls The encrusting forms thicken slowly, but push out their edges rapidly, more than 20 mm being recorded in four weeks *Goniolithon*, as finely branching growths, affects the surfaces of barrier and atoll reefs, behind the actual edge zone, which is covered almost entirely by incrusting *Lithophyllum*, pushing up into branching but rounded masses This genus is abundant in places down to 10 fathoms on the seaward slopes, but gradually *Lithothamnion* becomes the dominant plant builder, its deeper species, small branched but rather delicate detached growths, often completely covering the whole surface All genera belong to the encircling reef, atoll, or barrier, not occurring on lagoon shoals or floor

The sedentary animal builders are all cœlenterates Of first importance are corals (*Madreporaria*), the builders here being all massive or branching forms, each a single animal but with vast numbers of feeding and breeding organs in its polyps Then there are the stinging hydroid (*Millepora*) and the blue coral (*Heliopora*) which grow generally to form massive upstanding plates, the animal matter forming a surface film perpetually depositing its lime below The last is an alcyonarian and there must be added a series of forms from this group, the organ pipe coral (*Tubipora*) and the soft corals (*Sarcophytum*, *Sclerophytum*, *Lobophytum*, and *Xenia*), all of which form their lime in spicules which may play a considerable part in sand formation

In animals feeding is not so simple as in plants, and consists of three processes concerned with oxygen carbon, and nitrogen Oxygen seems to be the hydrogen acceptor in the respiration of both animals and plants A complication here is the considerably greater motility of animals, even in sedentary forms, and this implies the necessity of a more bountiful supply of oxygen as well as the casting out of waste products The last has been met by the evolution of nephridial kidneys in higher animals, but the excretion is probably a function of all free surfaces in sedentary cœlenterates calling for a special water circulation to remove such poisonous materials

These special difficulties in respect to the nutrition of coral building sedentary animals in tropical waters have been met by the taming ' of unicellular green flagellates (*Zooxanthella*) by the polyps—or the polyps being adopted by such plants—housing them as symbionts in their endoderm cells In 1896, at Rotuma I found corals from which oxygen was being given off, and subsequent observations in the Maldives and on the Sladen Expedition convinced me of the importance of this phenomenon, of which Dr C M Yonge, of the Great Barrier Reef Expedition, has recently given experimental proof. Such oxygen production on the part of these symbiotic algæ implies the formation of much carbohydrate material, and in the absence of specially rapid fission in the algæ we may infer the passage of much of this to the polyps Thus we may suppose the alga to be largely responsible both for the oxygen and for the carbohydrates required by the polyps But it is possible that the alga is of even greater importance as a scavenger which

* Substance of a lecture before the Linnean Society of London on Mar 19

thrives on the waste products of its animal The utilisation of the animal s carbon dioxide is probably of small importance for its disposal is easy, and the polyp during the daylight in which the alga s chlorophyll is alone functional is largely quiescent The utilisation of the animal s nitrogenous waste products probably provides the alga with its sole available source of nitrogen the other salts required quite likely existing as such in the protoplasm of the polyp In this connexion the absence of other non infected kinds of cœlenterates and of Polyzoa from the shallower waters of coral reefs is significant

The depth from which our coral reefs of to day grow is that at which photosynthesis is active This is about 60 fathoms for plants and 45 fathoms for the plant animals as maxima These depths fluctuate in accordance with the turbidity of the water which increases in the proximity of land masses and decreases in the Pacific and Indian Oceans from east to west probably in correlation with the eastern influx of polar waters This turbidity is largely due to unicellular algæ and a second factor is introduced by their utilisation of any carbon dioxide in the water to the detriment of reef building organisms That plants would be affected is clear and it is hard to believe that polyps would provide sufficient carbon dioxide both for their symbionts and for their lime skeletons On reefs the presumption is that their extra requirements are met by their algæ breaking up the bicarbonates of the lime saturated sea water thus amorphous lime may be found precipitated on the tissues of the free parts of the polyps Where there are active water movements it is presumably swept away in the consequently heavy mucous lubrication of the surfaces but in the deeper lagoons and in other areas of still water the lime clings to the polyps and kills them This up to the present is the only suggestion which explains why lagoons have singularly little coral and algal growth on their floors and that upgrowing shoals do not occur in lagoons except in the proximity of the passages into them

The rapidity of growth of coral building organisms is well known and independent estimates agree that a reef might grow up from 14 fathoms to the surface in a thousand years but the speed of its deposition is not material to our hypothesis The horizontal outgrowth of reefs is considerable but it depends on the extension of their foundations by their own talus material On the earth s crust below the reef there is a weight of 2½ times that of the sea water replaced by the coral reef an increase of 150 per cent Can these or the analogous weight alterations found in the formation of many geological strata be reacting on the earth s crust to produce subsidences ? We can give no reply for we have few data as to the strength of the earth s crust and as to the detailed topography of the oceanic slopes off coral reefs but no one with experience of the Pacific Ocean can doubt the activity of crustal movements even to day This question must be tested and it is not beyond the scope of the geophysicist, who should be able to tell us at what depths below atolls limestone is underlaid [by] igneous and other rocks pro

Solution of limestones is largely a chemical matter and this side has been suy dealt with in respect to the coral reef by many workers Lagoons are suppos formed by solution and by the removal of mu in suspension Generally organisms are only mentioned as providing carbonic acid gas by thei decay to help the solution The mud is accepte as an expected formation wherever land or reef occur few observations on its production having been made Yet this is of great importance since it entails the study of the decay and grinding up of coral rock in which nearly all the facts are biological current action not being considerable on reefs that are clothed by living organisms Every mass of limestone is visibly bored into by organisms—molluscs worms sipunculids sea urchins and certain barnacles Some of these grind their tunnels while others dissolve them out most using both methods

As a result of the examination of many specimens I believe it is seldom that more than 40 per cent of the mass is thus removed by these animals Larger figures were obtained from sponges but on the whole they are not such important boring organisms in tropical as in temperate seas But on coral reefs I find that all limestones massive rocks corals nullipores stones and pebbles are penetrated by a network of the finest threads which are clearly algal in nature These are the chief boring organisms of coral reefs and the primary cause of the reduction of limestone to pebble sand and mud a whole sequence of organisms aiding them They bore solely by solution and while molluscs probably bored primarily for protection many other forms may well have been seeking for the nutriment these algae provide

In living corals the boring hyphæ advance in the corallum so close to the polyps that we can even imagine the latter being thrown down to fend them off In nullipores they enter the skeleton less easily and their action is slower and less marked I have tried by various means to estimate their actions but the error factor is too great to make any figures of real value partially because I have not found bored and unbored parts of the same coral skeleton In undisintegrated coral skeletons of which the polyps were living our figures vary from 10 to 60 per cent of the coral dissolved away while in dead corals of the same species the figures are 40 to 83 per cent The last figure is exceptional because usually the coral breaks up into pebbles long before it becomes so reduced but the boring algæ still live in these until smothered by mud or consumed by sand feeding organisms In any case the solution of limestone by boring algæ is a primary feature in shaping coral reefs and one deserving of the closest investigation by modern methods applied upon the reefs themselves In particular it would be useful to ascertain whether the importance of these forms observed by me on Maldivan material is applicable generally to the formation of all coral reefs

The Nature and Origin of Ultra-Penetrating Rays.

THE meeting of the Royal Society, held on May 14, was devoted to a discussion on ultra-penetrating rays In his opening address * Prof H Geiger outlined three main lines of experimental investigation, referring first to the results of direct absorption measurements, and in particular to the very beautiful measurements of Millikan and Cameron, and of Regener, which together furnish a complete series of ionisation measurements from an altitude of 5 km down to a depth of 240 metres below the surface of Lake Constance Since, in traversing 240 m of water, a particle will make many hundreds of collisions with oxygen nuclei, it is highly improbable that the ionisation at these great depths is produced by corpuscular radiation On the other hand, the shape of the lower portion of the absorption curve is in good accord with the assumption that the ionisation is produced by photons Appropriate analysis yields the value $\mu = 0\ 02$ metre^{-1} for the true absorption coefficient of the hardest component, which, according to the generally accepted formulæ, corresponds to a quantum energy of about $3\ 7 \times 10^9$ electron volts

According to the Einstein mass energy relation, the emission of this amount of energy is necessarily accompanied by a loss of mass equal to that of two protons This fact naturally suggests that the radiation in question may arise through a new type of disintegration, taking place in a heavy nucleus, in which two protons and two electrons unite in self-annihilation If we assume that the annihilation takes place in free space, then it would appear that momentum can only be conserved during the process by the simultaneous emission of two quanta of equal energy The appearance of quanta of energy $3\ 7 \times 10^9$ electron volts would in this case signify the annihilation of four protons and four electrons, that is, a helium atom As is well known, astrophysical data appear to indicate that matter is being annihilated continuously within the stars There are, however, strong arguments against the hypothesis that ultra penetrating radiation is of stellar origin

It was pointed out in discussion by Prof F A Lindemann that only the penetrating radiation generated in the surface layers of the star is able to escape, so that even if the rate of generation of energy at the centre is no greater than at the surface, the amount of energy escaping as penetrating radiation ought to be an infinitesimal fraction of the whole, whereas the energy reaching the earth's surface in the form of the hard component alone is more than 1 per cent of the total energy of starlight. Several attempts have been made to obtain evidence of penetrating radiation coming from the sun Dr G M B Dobson referred to the recent investigation by Hoffman and Lindholm, who made a very careful series of measurements extending over about a hundred days, and found that the intensity was 0 5 per cent greater during the day than during the night Attributing the additional effect during the day to the sun, we obtain a more reasonable value for the ratio of the emission in the form of penetrating radiation to the total emission, but there still remains the problem of accounting for the enormously increased emission of the stars.

If penetrating radiation is of cosmic origin, it is therefore likely to originate not in the stars, but in the extremely diffuse matter in inter stellar space, a conclusion which might account for the absence of any marked variation of intensity of the radiation coming from different directions in space It has indeed been a very real difficulty of the hypothesis of stellar origin, that in spite of the relatively high density of matter in the galactic plane, no increased intensity is observed from this direction Prof F Regener ventured to speculate upon the possibility that the radiation which we are observing now comes principally from our own galaxy—but was generated in a previous cycle of the universe, some 10^9 years ago If the universe is closed, as Einstein supposes, such radiation might be refocused, as it were, upon the galaxy, but with sufficient blurring of the image to account for the observed uniformity of intensity

Commenting on this communication, Sir Arthur Eddington said he doubts whether the universe is sufficiently accurately spherical for the necessary degree of focusing Prof Regener claimed that at least this hypothesis had the merit of doing away with all difficulties concerned with the mode of generation of the radiation, for, in a complete cycle, the physical conditions may have changed entirely, so that interaction between matter and radiation of a kind now unknown may have been possible in a previous epoch While we may share Prof Regener's enthusiasm at the prospect of turning back a page in the history of the universe, the immediate line of advance must clearly be to endeavour to reach a solution by extending our knowledge of the universe accessible to experiment

If helium is being annihilated in interstellar space, it is just possible that the process might be detectable under laboratory conditions Lord Rutherford described how he had investigated this point by placing a number of cylinders containing helium at a pressure of 100 atmospheres round a high pressure ionisation chamber The presence of the helium certainly did not increase the ionisation by so much as 1 per cent of that due to penetrating radiation Since the mass of helium surrounding the chamber was equal to a layer of water 0 4 cm thick, it is easy to calculate, using Eddington's estimate of the total amount of diffuse matter in interstellar space, that if this matter consisted entirely of helium and was disappearing at the same rate as under the conditions of the laboratory experiment, it would only account for about one-fiftieth of the observed effects of penetrating radiation While it is possible that the complete annihilation of helium may only take place under the conditions of temperature and pressure existing in outer space, it is well to

* NATURE, May 23, p 785

remember that, in ascribing this origin to the hard component of penetrating radiation, we are presupposing the validity of the formula by which the absorption coefficient of the radiation was interpreted This formula, which only takes into account the scattering of quanta by the extranuclear electrons, has been tested very thoroughly for quantum energies up to two million volts, and found to account accurately for the observed absorption Is it not likely, however, as Lord Rutherford emphasised, that the more energetic quanta may interact also with the nucleus ?

Although this question is only just coming within the reach of experimental investigation, it appears almost certain that even quanta of two and a half million volts energy show a very marked interaction with the nuclei of the heavier elements The evidence for this interaction has emerged from a study of the γ rays emitted by thorium C″ As is well known, when a quantum is deflected through an angle θ by an encounter with an electron, its wave length is increased by an amount $\Delta\lambda = \frac{h}{mc}(1 - \cos\theta)$ Thus, however great the energy of the incident quantum, the wave length after scattering through, say, 120° will be greater than 36 X U It has been shown by Chao that if thorium γ-rays are allowed to fall on lead, and the absorption curve of the radiation scattered in a backward direction is analysed, there is, in addition, a hard radiation of wave length about 20 X U A more detailed investigation (unpublished), by G T P Tarrant and L H Gray, has shown that at a 120°, in addition to the soft scattered radiation, there are also present at least two other radiations of much shorter wave length, namely, $\lambda \sim 20$ X U and $\lambda \sim 12$ X U Similar radiations were also found when tin was used as scatterer in place of lead Moreover, by using a very inhomogeneous source of γ-rays, it was found that only quanta of energy greater than about two and a half million volts were capable of exciting the new radiation

These facts appear to confirm very fully the conclusions reached independently by Chao, Meitner, and Tarrant from direct absorption measurements, that part (at least 10 per cent) of the absorption of the thorium C″ γ-rays in heavy elements must be ascribed to the nucleus As the energy of the quantum increases, there is reason to believe that the contribution of the nucleus to the total absorption will become commensurate with that of the extranuclear electrons It is most important that this point should be settled experimentally, for it is difficult to believe that the ionisation produced at great depths is due to any other than quantum radiation, and even if this radiation is of secondary origin, its wave-length would set a lower limit to the energy of the primary corpuscular radiation At present this limit is about 4×10^9 electron volts

The second type of experiment to which Prof Geiger referred in his opening address is most naturally explained in terms of a corpuscular hypothesis It consists in observing the simultaneous discharge of two 'tube counters' by a suitable relay system Since it has been shown experimentally, using radioactive sources, that every β-particle passing through a counter produces a discharge, whereas only about 2 per cent of the γ-ray quanta are recorded, the simultaneous discharge of two counters will, apart from chance coincidences, be taken to indicate the passage of the same particle through both tubes In the experiments of Bothe and Kolhörster, two counters were arranged vertically above one another, and the number of coincident discharges was noted The ratio of this number to the total number of discharges of either counter was in rough agreement with the value calculated from geometrical considerations, so that the immediate ionising agent in the case of penetrating radiation has an efficiency in discharging the counter of something like unity On introducing a 4 cm block of gold between the counters, a reduction in the number of coincidences of only 24 per cent was observed, which is approximately the reduction that this block would produce in the total ionisation Bothe and Kolhörster concluded that since, in this case, the corpuscular radiation was of the same penetrating power as the total radiation, whereas throughout the region open to experiment a secondary corpuscular radiation is always observed to be much less penetrating than the quantum radiation which generates it, the ultra-penetrating radiation was corpuscular

Referring to possible origin of radiation of this penetrating power, Prof C T R Wilson pointed out that thunderstorms are capable of generating electrons of energy 10^9 electron volts or even considerably more, and in numbers which should be far more than sufficient to account for the observed ionisation—in fact, the problem is rather to understand why we do not observe radiation of very much greater intensity arising in this way For, from the known proportion of radioactive atoms in the air, we know that about ten β-particles will be emitted per cubic metre per second, and of these, some will be ejected in such a direction as to be accelerated by the electric field of the thundercloud From time to time the accelerated β-particle will make a close collision with another electron in which the minimum energy necessary in order that the second electron should be accelerated by the field is transferred to the latter The number of fast particles thus increases with astounding rapidity—a single β-particle making one close collision every 10 metres would generate 10^{30} particles in a distance of 1 km Though the currents through thunder clouds do not reach this figure, the total energy of all the thunder clouds in action at any instant is about 100,000 times greater than that necessary to maintain the supply of penetrating radiation reaching the earth's surface

Experiments have been performed, however which appear to give evidence against the view that penetrating radiation consists of streams of very energetic β-particles Thus Rossi, and quite recently Mott Smith, using the coincidence counting method, have attempted to deflect the rays by a magnetic field In each case, the experimen

gave a negative result, though in the experiments of Mott Smith a 10^9 volt electron should have been deflected through 2 cm on reversing the field—a deflection that would have been easily measurable Since the momentum of a proton of 10^9 volts energy is only double that of an electron of the same energy, the negative result of this experiment conflicts also with the suggestion of Prof Geiger that the radiation consists of streams of protons

Considering that the range of energy open to experimental investigation is only a few million volts, however, it is scarcely surprising that no satisfactory hypothesis can be framed to account for phenomena exhibited by radiation of 1000 million volts energy L H G

Obituary.

PROF ALFRED WEGENER

THE death of Prof Alfred Wegener, leader of the German expedition to Greenland, has now been confirmed By this event the sciences of meteorology and geophysics have lost a very valuable worker

Alfred Wegener was born on Nov 1, 1880 He studied at the Universities of Berlin, Heidelberg, and Innsbruck, obtaining the degree of Ph D, at Berlin, with an astronomical thesis He took part in a Danish expedition to Greenland under Mylius-Ericksen in 1906–8, taking charge of the meteorological work, including upper air observations with kites and captive balloons, and later summarising the observations for publication He was a brother of Kurt Wegener, well known as a balloonist, and he took an active interest in his brother's work From 1906 until 1908 the two brothers held the world's record for duration of balloon flight with a flight of 52½ hours

Wegener accompanied Col Koch to Greenland in 1911–13 As an officer of the reserve, he served in the German army during the war of 1914–18, and was awarded the Iron Cross of the second class In 1916 he was appointed to the meteorological service of the German army, and was meteorological adviser on a number of Zeppelin flights After the War he joined the Deutsche Seewarte at Hamburg, and in 1925 he was appointed professor of geophysics and meteorology at the University of Graz

Wegener's expedition to Greenland in 1929 was preparatory to the fourth, in which he perished He set out from Kamarujuk in lat 71° N, on the west coast, on April 1, 1930, and by the end of July had established a station on the central ice, about 250 miles from the coast Wegener again set out in September with Dr Loewe and a party of thirteen Greenlanders, with supplies and instruments for the observers at the central station, and he started with one Greenlander, Rasmus, on the return journey to Kamarujuk on Nov 1 His non-arrival at the coast caused no uneasiness at first, as he was thought to have stayed at the central station, and it was only in late April that a search party was sent out Wegener's body was found buried in the snow, but so far his companion, Rasmus, has not been found

Wegener's contributions to meteorology included a number of papers on the investigation of the upper atmosphere, but his best known contribution to pure meteorology was a text book, "Thermodynamik der Atmosphäre", which appeared in 1911, and of which a third edition appeared in 1928. This is a particularly valuable book, in that it emphasises the physical aspects of meteorology At the time of its first appearance it was almost the only text-book which gave a physical account of the processes of weather, and it remains a valuable part of the literature of a subject in which good text-books are rare

In recent years Wegener has been better known as the author of the theory of 'continental drift', which was set forth in 1915 in the first German edition of "The Origin of Continents and Oceans" Later editions of this book appeared in German in 1920, 1922, and 1929, it was translated into English in 1924, and has also been translated into French, Russian, Swedish, and Spanish Wegener claims that the continents are rafts of granitic rock floating in a heavier basaltic magma, and therefore free to move relative to each other and to the poles He maintains that the continents have changed their positions considerably during geological times, and so accounts for the great apparent variations of geological climates and especially the glaciation of regions now within the tropics The climatological aspects of the theory have been set out very clearly by W Koppen and Wegener in "Die Klimate der geologischen Vorzeit" It cannot be said that general agreement has been reached on this subject, as can readily be seen by reference to the report of a discussion on this and kindred topics held at the Royal Society on March 27, 1930 (see *Proc Roy Soc*, B, vol 106, p 299, NATURE for April 5, 1930, p 546) Wegener's ideas have, however, stimulated research in a marked degree, and his early death is a great loss to geophysical science

Wegener's expedition to Greenland was part of a co ordinated scheme of British, German, and American co operation in an investigation of the weather conditions over the great inland ice sheet of Greenland The British expedition made a similar attempt to that of Wegener to set up a station in the centre of Greenland, but farther south, in the latitude of Angmagssalik The narrow escape from death of Mr Courtauld shows the dangerous nature of these attempts to solve the problems of the meteorology of Greenland It is anticipated that the meteorological results obtained from the centre of Greenland and from the American station at Upernivik, on the west coast, will have important bearings upon the weather of Europe and America, as well as upon the practical problems of possible air-routes to Canada, which was a special subject of study by the British expedition D B

Dr Thomas Ashby

We regret to record the death of Dr Thomas Ashby, the leading English authority on the archæology of Rome Thomas Ashby was born on Oct 14, 1874, and was educated at Winchester and Christchurch, Oxford, where he took first-class honours in Classical Moderations and Literæ Humaniores He won the Craven Scholarship in 1897, and in 1906, the year in which he took his doctorate of letters, he was also awarded the Conington Prize

As Ashby's father resided in Rome, his interests were almost inevitably directed towards the antiquities of the city in which he spent his vacations Under the guidance of Commendatore Lanciani, at that time the foremost authority on Rome, he became an enthusiastic student of the topography and history of Rome and the Campagna When the British School at Rome was founded in 1901 he became a student In 1903, he was appointed Assistant Director, and in 1906 became Director in succession to Stuart Jones He continued to hold this position until certain administrative changes were made in 1925, and his appointment, which was triennial, was not renewed Afterwards he resided in Rome without any official appointment During the War, Ashby served with the Red Cross on the Italian Front, where his knowledge of Italian was invaluable, and afterwards was interpreter to the British Military Mission with the Italian Supreme Command

Ashby's position as an authority on the archæology of Rome from the earliest times to the Renaissance was universally recognised as unrivalled His annual contributions to the *Times Literary Supplement* on the year's archæological work in Italy were packed with information concisely expressed, which showed that he had every detail of Italian archæology at his finger ends His knowledge of his subject was encyclopædic This characteristic grasp of detail, which, however, never failed to evolve a logically reasoned general plan, was particularly to be remarked in the accounts of his work of exploration which it was his custom to contribute to the proceedings of the British Association at its annual meetings For many years he carried out excavations on Roman sites in Britain for a Committee of the British Association, and was responsible for their excavation of Caerwent (Venta Silurum)

Ashby was the author of many papers which appeared in the *Papers* of the British School and in the periodicals of learned and scientific societies In 1927, he published "The Roman Campagna in Classical Times", and revised and edited "The Topographical Dictionary of Ancient Rome" left unfinished by Prof G B Platner He was the author of several works on the archæology of Roman Italy, of which the most notable was perhaps "The Aqueducts of Ancient Rome" He also published a volume of Turner's studies of Rome in which the letterpress was worthy of the painter's genius, and a book on Italian festivals and folklore Ashby was elected a fellow of the British Academy in 1927, and since last year had been a research student of Christchurch, Oxford Those to whom he gave his friendship could appreciate a warmth of nature which was not apparent on the surface, and they will long mourn their loss

Prof E P Culverwell

By the death on April 15 of Edward Parnall Culverwell, the scientific side of the University of Dublin loses one of its most untiring supporters E P Culverwell was born in 1855 He was the youngest son of Joseph Pope Culverwell He won a mathematical scholarship in Trinity College, Dublin, in his twentieth year, and a senior moderatorship in mathematics and experimental science in 1877 He was elected to a fellowship in 1883

By his marriage with Edith, daughter of the Rev Wm Fitzgerald, Bishop of Killaloe, Culverwell became connected with George Francis Fitzgerald , a connexion which may have been in some part influential in the life long interest of Culverwell in applied mathematics and in education, Fitzgerald being a very great exponent of both

Culverwell's earlier publications were a series of papers on the "Calculus of Variations" These appeared consecutively in 1892, 1893, and 1895 in the *Journal* of the London Mathematical Society In 1895 he contributed to the *Geological Magazine* two papers on "A Criticism of the Astronomical Theory of the Ice Age and of Lord Kelvin's suggestion in Connection with a Genial Age at the Pole" These papers will be in the recollection of many who may read these lines They criticise the earlier views of Croll and of Sir Robert Ball as regards the origin of the Ice Age They brought their writer into notice as a clear headed and incisive critic It is unnecessary to recapitulate the controversy Culverwell's arguments against the adequacy of Croll's theory as explanatory of the origin of the Great Ice Age appear to the present writer as convincing They are also inimical to the adequacy of Ball's views Culverwell rightly refers to the necessity of taking into account, as additional to direct solar heat, the considerable convective transport of heat at the surface of the globe An interesting résumé of the whole subject and of the nature of Culverwell's criticism will be found in "The Quaternary Ice Age", by Dr W B Wright (Macmillan and Co) of the English Geological Survey

Later in life, in the year 1913, Culverwell published "The Montessori Principles and Practice" (Bell and Sons) Culverwell at this time was professor of education in the University of Dublin This book—now out of print—is a most interesting study of a very great subject Indeed, the book is in itself so educational that the writing of it confers on its author the status of a most effective educationist

In 1890, Culverwell published a little book on "Mechanics and Dynamics", intended as an introduction to these subjects It contains many ingenious suggestions helpful to beginners J J

News and Views.

THE King's birthday Honours List contains the names of the following men of science and others associated with scientific work *Order of Merit* Sir William Bragg, in recognition of his eminent services in the advancement of science *Knights* Dr J B Baillie, vice-chancellor, University of Leeds, Col S R Christophers, director, Central Research Institute, Kasauli, Dr W C D Dampier Whetham, fellow of Trinity College, Cambridge, Dr P C Varrier Jones, founder and Medical Director of Papworth Village Settlement for the Treatment of Tuberculosis, Prof S R Krishnan, King George V professor of philosophy, University of Calcutta, Prof H Lamb, emeritus professor of mathematics in the University of Manchester, Mr C R Peers, president of the Royal Society of Antiquaries, Mr R L Robinson, vice chairman and technical commissioner, Forestry Commission *C I E* Dr L C Coleman, director of agriculture, Mysore State, Mr A McKerral, director of agriculture, Burma, Mr C A Malcolm, chief conservator of forests, Central Provinces, India *C B E* Dr Kate Barratt, principal of Swanley Horticultural College, Kent, Mr W J Hadfield, city engineer and surveyor, Sheffield, a pioneer in modern developments of highway engineering and road surfacing, Prof H M Hallsworth, David Dale professor of economics, Armstrong College, University of Durham, Dr Alice Werner, lately professor of Bantu languages at the School of Oriental Studies, London *I S O* Mr W H Moorby, assistant civil engineer in chief, Admiralty, Mr J B Scrivenor, director, Geological Survey, Federated Malay States

SIR ARTHUR KEITH, of the Royal College of Surgeons, has kindly forwarded to us the following cable addressed to him and dated May 26 "Child's skull found in Mousterian Breccia by MacCown of our expedition —Garrod" Miss Dorothy Garrod is in charge of excavations at the caves of Mount Carmel for the British School of Archæology in Jerusalem, and the party have evidently found a child's skull of Mousterian date The only human remains of this date previously known from Palestine were the fragments of the Galilee skull found by Mr Turville Petre in 1925, and two isolated teeth found by Miss Garrod in 1928 and 1929 The race represented by these fragments was the Neanderthal, and presumably the child's skull now found will also prove to be Neanderthal

ON May 27, Prof A Piccard, of the University of Brussels, accompanied by Herr Kipfer, ascended at 4 a m from Augsburg, Bavaria, in an airtight aluminium sphere, about 2 metres in diameter, raised by a balloon which was stated when fully inflated to have the enormous capacity of half a million cubic feet Anticyclonic conditions prevailed at the time, and the balloon after remaining in the air for 18 hours fell at a spot about 160 kilometres to the south Prof Piccard succeeded in reaching a height of about 16½ kilometres, probably penetrating into the stratosphere by some four kilometres, and beating all previous records of a manned balloon or aeroplane On the descent, trouble occurred with the gas valve, and after long delay the balloon landed safely on a glacier in the Austrian Tyrol, both aeronauts fortunately escaping unhurt

THE physical problem of raising a weight of perhaps a third of a ton to a height of 16 kilometres by means of a balloon is not in itself unduly difficult, it primarily reduces itself to a question of expense But to carry observers and bring them back alive is a very different proposition, and Prof Piccard and his assistant are to be congratulated on a very notable achievement The air in the cabin was renewed by two oxygen cylinders, each capable of maintaining a good atmosphere for eight hours As was to be expected, the aeronauts suffered considerable discomforts, and one strange anomaly was that at times the *temperature inside the sphere was most unpleasantly* high while the external air was 55° C below freezing point, due to intense solar radiation in the rarefied atmosphere Prof Piccard states that the balloon rose 15 kilometres in the first 25 minutes It is somewhat startling to learn that the stratosphere can be reached by observers after only 20 minutes' travel from the ground Of the scientific results obtained it is too early to speak

PROF PICCARD hoped to obtain evidence of the cosmic rays under more favourable conditions than have previously been possible, and his contributions in this field will be awaited with interest Meteorologists will be anxious to know if he has anything to tell them about the composition of the atmosphere within the stratosphere, even the amount of water vapour present there is not known, and more knowledge would be welcome regarding carbonic acid and ozone Observations with self recording instruments on unmanned balloons have already been made of cosmic radiation, atmospheric electricity, relative humidity, etc, but it is almost certain that in these cases very much better data could be obtained by eye observations, and in addition it should be possible to study the absorption of solar radiation of different wave lengths by the atmosphere at these great heights So successful an initial attempt would lead one to hope that much useful scientific information may be gained by this method in the future

SIR FLINDERS PETRIE gave his first lecture on the results of his past season's work in southern Palestine at University College, London, on May 28 The excavations have now reached a stage which reveals Ajjul as the home of the Hyksos or Shepherd Kings The Hyksos can no longer be regarded as mere nomads living in tents For centuries they held this city, strongly fortified and a key position on the road from Palestine to Egypt, and twenty times as large as Troy It must long have been a centre of commerce between Asia and Africa, for it had developed harbours and a system of weights and measures At one point of the excavations, three storeys of buildings were penetrated Eighty rooms full of debris, but

with doorways intact and walls also intact and eight feet thick, were brought to light In the tombs, human beings, horses, and asses are buried together Among them the 'great horses', which were imported for riding, were buried with special care Among the material found in the tombs was a quantity of flat bottomed pottery of a shape entirely non Egyptian It would appear that the city was abandoned about 2000 B C, probably, it is thought, owing to malaria Sir Flinders considers that there is still work for the next fifty years on Ajjul, but financial support for the work is needed

IN this connexion, we may refer to a letter which appeared in the *Times* on May 27 over the signature of forty students whose careers "have been moulded under the Professor's guidance" Directing attention to Sir Flinders Petrie's position as a pioneer in archæological discovery and its methods and aims, whether in field work or in research at home, they remind the public of his annual expeditions to Egypt, of which the results have been published fully for the use of students and popularised by lectures and in the press Beginning with his triangulation of the Pyramids, they go on to point out, his excavations in the Delta, Upper and Middle Egypt, and in Sinai and Palestine through the Badarian, prehistoric, and dynastic ages have linked up Egypt and Europe and have revealed ancient civilisations as a connected whole This tribute, no more than is merited by a lifetime devoted, with brilliant results, to archæological research, in which a wide circle will concur, is made the ground of an appeal for financial support for the continuance of training of archæological students The two existing scholarships, one for biblical research, the other in memory of Gertrude Bell, are in need of maintenance, and money is urgently required for the actual digging in the field

FOUNDED in 1881, the Society of Chemical Industry this year celebrates its jubilee The celebrations, which will be held in London and will occupy the seven days commencing July 13, begin with a meeting at the Guildhall at which additional guests may attend provided application is made for a ticket in advance, in the evening there will be a reception by the president, Sir Harry McGowan, and Lady McGowan, at the Great Central Hotel On the following day, the annual general meeting will be held at the Royal Academy of Music Marylebone, it will be followed by luncheon by invitation of the London section, and a garden party at Teddington The evening will be devoted to receptions and a lecture On July 15, the Society's medal will be presented to Dr Herbert Levinstein, who will deliver an address, meanwhile a party will visit places of interest in London Six alternative industrial visits are planned for the afternoon, members may visit the General Electric Research Laboratories, Messrs Watney, Combe, Reid and Co's Mortlake Brewery, the works of the Wall paper Manufacturing Co, Ltd, Achille Serre, Ltd, the British Drug Houses, Ltd, or the South Metropolitan Gas Co The annual dinner will be held in the evening, when the principal guest will be H R H Prince George Since this function is reserved for gentlemen, the ladies accompanying members will be the guests of the Society at dinner and at an entertainment Various alternative engagements have been made for July 16 A party will spend the day at the Rothamsted Agricultural Research Station, other members have the choice of attending meetings for the reading and discussion of papers, or of listening to addresses delivered by two of the new honorary members One of these addresses will be delivered by Dr H Sørensen on "Hydrogen Ion Concentration"

CHEMICAL industry includes the important branch of food manufacture and control, and a party of members of the Society will be invited by Messrs J. Lyons and Co, Ltd, to luncheon, followed by visits to Cadby Hall and to Greenford In the meantime, other parties will, in the afternoon of July 16, pay visits to the National Physical Laboratory and Chemical Research Laboratory, Teddington, to the research station of the Distillers' Co, Ltd, at Epsom, to the laboratories of Messrs Burroughs Wellcome and Co at Dartford, to the Fuel Research Station at Greenwich, or to the Pyrene Co and the Firestone Tyre and Rubber Co In the evening, a reception will be given by the president and Lady McGowan On July 17, there are three all day excursions to Messrs Huntley and Palmer's biscuit factory at Reading, to the Research Station of the Anglo Persian Oil Co at Sunbury on Thames, or to Windsor Castle and Eton College, in each case the arrangements include a river trip The evening function is a reception and dance by invitation of the directors of Imperial Chemical Industries, Ltd, at Imperial Chemical House, Millbank, Westminster Oxford will be visited by road on July 18, opportunity being afforded for the inspection of the Bodleian Library, the colleges and the chemical laboratories On Sunday, July 19, Canadian and American visitors will leave for their tour of the Midlands, the Lake District, and Scotland Arrangements will be made for those who so desire to attend morning service at St Paul's Cathedral, whilst the afternoon will be occupied by visits to Hampton Court or to the Zoological Gardens Throughout the week there will be an exhibition of chemical plant and research instruments at the Central Hall, Westminster Applications for participation in the celebrations, with the appropriate fees, will be accepted until June 30 The office of the Society of Chemical Industry is at 46 Finsbury Square, London, E C 2

MMES SOPHIE BOTCHARSKY and Anna Foeringer in a short letter on page 856 of this issue describe some photographic effects of vitamins A and B observed by them It has been suggested by several observers that certain substances give off radiations to which their biological activity may be ascribed, thus Kugelmass and McQuarrie (*Science*, vol 60, p 274, 1924) found that when cod liver oil was made alkaline and oxygenated it affected an air tight photographic plate through a quartz window Other workers failed to confirm this result Drummond and Webster (NATURE,

vol 115, p 837, 1925) state that many substances undergoing autoxidation will fog a plate, vapour being given off They suggest that in Kugelmass and McQuarrie's experiments the plate was not in an air-tight container, or alternatively that the fogging was due to the fused quartz emitting a phosphorescence Daniels and Fosbinder (*Science*, Sept 18, 1925, p 266) repeated Kugelmass and McQuarrie's experiments and were unable to confirm them Peacock found that cod liver oil became fluorescent on exposure to a bright light and that there was possibly some relationship between its vitamin A activity and fluorescent power but none between the latter and its vitamin D content (*Lancet*, vol 2, p 328, 1926, and also Samson Wright, *J Physiol* vol 61, p 36) More recently Hugounenq and Couture (*Compt rend*, vol 188, p 349, 1929) found that cholesterol obtained from cod liver oil darkened a photographic plate when in contact with it or separated by a quartz (but not a glass) plate

ON June 1 the survey ship, H M S *Challenger*, built by the Admiralty for the Ministry of Agriculture and Fisheries, was floated out of dock at Chatham The ceremony was performed by Miss Addison, daughter of the Minister of Agriculture and Fisheries The construction of this ship is the outcome of an interim report of the Fisheries Committee of the Economic Advisory Council, which recommended that His Majesty's Government should undertake an organised search for new fishing grounds The ship, which has been specially constructed for exploratory work in northern waters, is an oil burning vessel, 220 ft in overall length, having a displacement of 1400 tons and a sea endurance of 9500 miles The Hydrographic Department of the Admiralty will undertake the survey work, and it is hoped that important new fishing grounds will be discovered and charted The name *Challenger* has very appropriately been chosen for the ship, to perpetuate the memory and the traditions of the famous voyage of H M S *Challenger* in the years 1872–1876 That voyage is justly regarded as having laid the foundations of scientific research at sea Although the new ship is not expected or intended to carry out, like her famous predecessor, a circumnavigation of the world, anyhow at present, and her immediate objective may make less appeal to the imagination, she starts with enormous advantages in the form of the most up to date equipment for scientific research, and may be counted on to maintain the high traditions associated with her name

MR A COURTAULD's own account of his five months' stay alone on the Greenland ice cap was published in the *Times* of May 29 The party that arrived at the station to relieve the occupants in December was faced with the alternatives of abandoning the station or leaving only one man, since the supplies of food and fuel were not sufficient for more Mr Courtauld then offered to stay alone The station was a tent, ten feet in diameter, with double walls and covered with snow, through which a metal ventilator protruded Two snow houses reached by a snow tunnel contained stores, and an outer snow wall enclosed the whole Until March, all went well in spite of heavy winds and frequent gales, but on March 21 the station was completely snowed up, and from then until the relief on May 5, Mr Courtauld was unable to leave the tent, in which he lived in darkness, without even sufficient light to see what he was eating Observations, of course, had to cease when he was cut off from his instruments Mr Courtauld notes that the temperature in January was not very low, and that on one occasion it rose to 20° F By the end of February colder and finer weather set in Fifty degrees below zero was frequently observed The lowest temperature recorded was 64° below zero The strong winds were generally from the north west The station was so completely buried that Mr Watkins' relief party found it only by the remains of its flag and its ventilator shaft projecting above a uniform plain of snow

THE Very Rev Dr W R Inge, Dean of St Paul's, delivered a Friday evening discourse at the Royal Institution on May 29 on "The Future of the Human Race" Dr Inge described in outline the England of a thousand years hence as he would like to see it The population has been stabilised at about twenty millions, and certificates of bodily and mental fitness are required of would be parents London remains as a large city, but the majority of the people live in villages and small towns Mental and physical tests form a regular part of school and university training, and the results, with family histories, are registered Physical perfection confers the prestige now given to social position Most nations are nearly self supporting and food is cheap and abundant There are no wars and the functions of the central government are almost nominal There are no opportunities for making large fortunes, and indeed there is no longer any motive for living pretentiously Hours of labour are short, but serious hobbies are encouraged Broadcasting has partly superseded lectures and concerts, and air travel has much extended, so that intercourse with foreign people is easy Dr Inge warned us, however, that civilisation contains the seeds of its own dissolution Physical evolution seems to have come to a standstill While the human brain was very immature, man began to use tools, and, if we do not take care, we are in grave danger of becoming parasites of our tools

IN his Ludwig Mond lecture at the University of Manchester on May 19, Prof William McDougall directed attention to the laggard progress in the biological sciences as compared with the rapid rate at which physical science had progressed since Galileo Psychology, economics, political science, jurisprudence, sociology really mark gaps in our knowledge or fields of possible sciences that have as yet scarcely begun to take shape or being These regions, in which chaos still reigns, must be reduced to order if our civilisation is to endure The responsibility for the backwardness of the human sciences was apportioned by Prof McDougall partly to the opposition of the churches, which he asserted still largely shape and control our

universities, to biological studies, which revealed man as a part of Nature, and to studies of his beliefs, superstitions, and customs, and partly to the general acceptance of the mechanistic theory The discoveries of physical science have multiplied mankind and added immensely to the delicacy, intimacy, and importance of relations between men and groups, but have given no guidance in the handling of the new complexities Prof McDougall considers that only the biological, and especially the social sciences founded on biology, can save us from the grave disorder and chaos that threaten us Social sciences must be actively developed into real sciences, and a science of human nature must be created Our most powerful intellects should be diverted from physical sciences into research on the biological, human, and social sciences, the attack being concentrated first upon anthropology, and an attempt should then be made to build the social sciences—especially the science of economics on the results of such anthropological research

THE progress report issued by the Radiostat Corporation is of value, as it shows that considerable advances have been made in the development of Dr Robinson's invention To the general public the 'Stenode Radiostat' wireless receiving set will be of great interest, as it provides an instrument of high selectivity which will permit the hearing of broadcasting stations the wave lengths of which are very close together When put on the market, it will provide a means of largely increasing the number of stations receivable with good quality and without interference in a given locality Under the broadcasting scheme adopted in Europe, the number of channels available between 200 and 550 metres is approximately a hundred, but the number of stations actually in use is greatly in excess of this The difficulties arising from interference are surmounted to a certain extent by assigning certain channels to groups of stations all working upon the same frequency In the United States, where there are far more broadcasting stations than in Europe, group working is only a partial remedy It has been found necessary, in addition to grouping stations, to assign to each certain hours during which it is allowed to be in operation The rapid increase in the number of high power stations, both at home and abroad, is introducing still further complications These stations have a considerable 'spread' at short and medium ranges A receiving set designed for a nine kilocycle selectivity may be completely paralysed if it is operated within twenty miles of stations like Brookman's Park, Daventry, or Moorside Edge The owner of a large and expensive set of the older type will probably find, when the projected nine high powered transmitters are working in Great Britain, that possibly Rome and Stockholm will be the only foreign stations that will be heard without interference

THE third annual general meeting of the British Society for International Bibliography was held in the Science Museum, South Kensington, on April 16 The Society exists to promote the study of bibliographical methods and the classification of information, to secure international unity of bibliographical procedure and classification; and to foster the formation of comparative and specialist bibliographies of recorded information The Society is particularly interested in facilitating the adoption of the Universal Decimal Classification of the Institut International de Bibliographie, Palais Mondial, Brussels, of which Institut the Society is the British National Section This system of classifying books and articles in periodical literature has been referred to in previous issues of NATURE During the past year the Society has enjoyed very close relations with the Association of Special Libraries and Information Bureaux, and a Joint Committee of the two institutions is actively promoting the adoption of the Universal Classification The membership of the Society includes representatives of most of the specialised branches of pure and applied science Ordinary meetings are held from time to time, but the Society makes a special feature of assisting members by personal contact and correspondence in any problems of indexing literature with which they are concerned Particulars may be obtained from the Secretary, British Society for International Bibliography, Science Library, Science Museum, South Kensington, S W 7

IT is announced in *Science* for May 15 that the American Association for the Advancement of Science, and about twenty five other scientific societies, will hold scientific sessions at Pasadena on June 15–20 This will be the eighty eighth meeting of the Association and the first of a new series of annual summer meetings The meeting will be under the presidency of Prof Franz Boas, of Columbia University, who is known for his contributions to anthropology, and in his honour a special symposium on 'The Antiquity of Man' has been arranged Prof Boas's presidential address will be on "Race and Progress" On June 17, Dr Arthur Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington, will speak on "The Present Status of Seismology", on June 18, Dr C A Beard, the historian will speak on "Scientists and History", and on June 19, a symposium on "The Impact of Science upon Civilisation, Past, Present, and Future", will be held Another interesting symposium has been planned on "Oceanographic Problems", and will be conducted by Dr T Wayland Vaughan A special session of the zoologists and biologists in honour of a former president of the Association, Dr David Starr Jordan, who has just celebrated his eightieth birthday, has been arranged

THE Annual Report for 1929–30 of the Scottish Marine Biological Association shows the laboratory of the Millport Marine Station to be in a flourishing condition So much have its activities increased that more accommodation will almost certainly be required in the near future Already four new tanks for live specimens have been added and more space has been made available for storage Much good work has been done, as is shown by the list of published work Miss S M Marshall and A P Orr have continued their researches in diatoms, studying for another year the spring increase in Loch Striven H B Moore has been

investigating the sea mud in the Clyde sea area, with important results, and R G Neill has completed and published a paper on the habits and feeding mechanisms of the polychæte *Nephthys cæca* Dr J A Cranston and Dr B Lloyd have isolated one of the denitrifying bacteria from the Clyde sea area, the cultural characters of which do not conform entirely with those of any known species This has been studied in detail and a type culture has been lodged with the National Collection of Type Cultures at the Lister Institute Researches have also been made on the spat fall and rate of growth in certain molluscs, and shore surveys have been continued Vacation courses for students are steadily growing in importance, and demonstrations or addresses have been given by the staff to classes and parties from various organisations

A PROPOSAL for the institution of national parks in Africa for the preservation of wild life is made by Major R W G Hingston in a paper in the *Geographical Journal* for May The spread of cultivation, the demands of trade, and the activities of the sportsman are seriously depleting the fauna Several large animals have been exterminated by human agency They include the blaubok, the quagga, and Burchell's zebra The white rhinoceros, the gorilla, the nyala, and Grevy's zebra are on the verge of extinction Game reserves, of which several exist in Africa, are useful but not entirely effective, because they have not a permanent status At present there are only two areas that have the status of national parks These are the Kruger National Park in the Transvaal and the Parc National Albert in the Belgian Congo Major Hingston outlines a scheme of nine other national parks These are (1) South Central park, including the Kasungu game reserve in Nyasaland, (2) Nyala park, two small areas in the south of Nyasaland which are both reserves, (3) Selous park, now the Selous game reserve of Tanganyika, especially for the preservation of the elephant, (4) Serengeti park, to the south east of Victoria Nyanza, which would shelter many species of grassland animals, (5) Kilimanjaro park, at present a game reserve, (6) Kenya park, to the south east of Lake Rudolf, (7) Bongo park, on the Aberdare mountains north west of Nairobi, (8) Bunyoro Gulu park, now a reserve, on the north east of Lake Albert, around the Victoria Nile, and (9) Gorilla park, in the Kivu district, for the preservation of the gorilla

"THE Animal Year Book," vol 1, 1931, is a work of information and of reference issued by the University of London Animal Welfare Society, the object of which is the furtherance of a "proper understanding of the right relationship between man and the lower animals" It contains an excellent summary of the law of Great Britain relative to cruelty to animals, a series of short notices of the state of animal welfare in some foreign countries, and useful articles upon various aspects of the cruelty problem Occasionally there is a tendency to push propaganda at the expense of truth, as when the suffering of trapped fur animals is stated to be roughly comparable to crucifixion (p 90), or when the snaring and trapping of rabbits are said to be on a par with the medieval torture of human beings (p 104), but such statements are exceptional, and the definite aim of the Society to deal with the prevention of cruelty in a reasonable way will commend itself to many sympathisers In one of the book reviews—a special feature of the Year Book—reference is made to recently invented, and presumably effective, humane rat traps (p 152) May we suggest that the illustration and description of such implements would make a most informative and useful appendix to such a work as this

THE introduction of the fur bearing musquash to Scotland for breeding purposes, and the subsequent escape from captivity of some of the animals, may have serious consequences T M Munro states, in the *Scottish Naturalist* for May, that in three different areas musquash have escaped and have made themselves at home in the open Indeed, in one area, near the banks of the Allan, as many as sixteen musquash 'houses' were in existence, until floods in 1929 washed most of them away Other localities are at Thornhill, Dumfries, and on the Bervie water in Angus, but the present writer failed to trace any wild musquash in the latter district during a recent visit The risk of the introduction is that the creature may find the climate congenial and may spread, to the destruction of river embankments and crops On the other hand, it may find it difficult simply to keep up the standard numbers We cannot tell, but it is wise in such a case to err on the safe side

THE preservation of photographs of scenery and of natural history events has become an acknowledged part of the business of the great museums, and such collections may become invaluable for reference in the future But their present value also is often very great What could be more informative in its own line than the series of photographs published in the *Natural History Magazine* for April, illustrating the shelters and beds built by gorillas for their nocturnal rest? Few people have seen these simple structures and photographs of them are real additions to scientific knowledge The pictures form part of an album of enlargements of photographs taken in the Beringa mountains, north east of Lake Kivu, by Mr Marius Maxwell, and they were presented by him to the Department of Zoology of the British Museum (Natural History)

THE conquest of a fatal disease, leukæmia, appears to be within sight This disease is not common, though every hospital of any size is likely to have at least a case or two every year, it is characterised by an enormous increase in the leucocytes or white corpuscles of the blood According to a recent *Daily Science News Bulletin* issued by Science Service, Washington, D C, Dr Hueper and Miss Mary Russell, working in the Cancer Research Laboratory of the University of Pennsylvania, have grown the leukæmic leucocytes in tissue culture outside the body, and treating rabbits with these cultures a serum is obtained which inhibits the increase of white cells *in vitro* and also in the body One human case of the disease has been treated with this 'anti-leukæmic' serum, with remarkable improvement

The report of the Irish Radium Committee for 1930 was presented before a meeting of the Royal Dublin Society held on April 28 The recent purchase of an additional half gram of radium has rendered possible a large increase in the amount of radon available, with a consequent increase in the number of patients treated The death of Dr W Stevenson, who was one of the pioneers of radium treatment, has, however, prevented the publication of his report on several hundred patients who were treated by him in 1930 Reports by other users give particulars of the treatment of 311 malignant and 44 non-malignant cases In many cases highly satisfactory results were obtained The difficulty of obtaining any information as to the state of patients who have returned to their homes in the country after treatment in Dublin hospitals presents, however, a serious problem

Referring to the population problem of Tyneside, we suggested (Nature of May 16, p 756) that the situation might possibly be readjusted by revival of local industries instead of by loss of population In this connexion, it is of interest to learn that the Department of Economics of Armstrong College, University of Durham, has undertaken, at the request of the Government, an economic survey of the industries of the north east coast of England The purposes of this research are to examine the existing industries of the area and to determine whether any of them are ever again likely to employ the same amount of labour as in the past, and to inquire into the possibilities of establishing new industries to absorb surplus labour The conclusions arrived at will be put before the Council of Armstrong College towards the end of the year and forwarded to the Government The Universities of Glasgow, Manchester, and Wales (Cardiff) have been asked to conduct similar surveys of their areas

The eighty fourth annual meeting of the Palæontographical Society was held at Burlington House, London, on May 29, Dr F A Bather, president, being in the chair The annual report recorded the publication of instalments of the monographs on Corallian Lamellibranchia, Gault ammonites, Palæozoic Asterozoa, and macrurous Crustacea It also announced the completion of the macrurous Crustacea in the next annual volume, and the publication of a second supplement to Girvan Trilobites Prof P G H Boswell, Prof H L Hawkins Dr C J Stubblefield, and Mr W F Swinton were elected new members of council, and Dr F A Bather, Mr Robert S Herries, and Sir A Smith Woodward were re elected president, treasurer, and secretary respectively The president delivered a brief address on phylogeny and classification, during which he expressed doubts as to the value of a classification based on phylogeny

The Thomas Young Oration of the Optical Society will be delivered at the Imperial College of Science and Technology, South Kensington, on Thursday, June 11, at 8 P.M., by Sir John Parsons, who will take as his subject "Young's Theory of Colour Vision"

The Huxley Memorial Lecture, 1932, of the Imperial College of Science and Technology will be delivered by Mr. Aldous Huxley, on "Huxley as a Literary Man", in the Royal College of Science, Exhibition Road, S W 7, on Wednesday, May 4, 1932, at 5 30 P M

At the anniversary meeting of the Linnean Society of London held on Thursday, May 28, the following officers were elected —*President* Prof F E Weiss; *Treasurer* Mr Francis Druce, *Secretaries* Mr John Ramsbottom (Botany) and Lieut Col John Stephenson (Zoology) The Linnean Gold Medal was awarded to Prof Karl Ritter von Goebel

At the spring convocation on May 6, the doctorate of laws was conferred by Queen's University, Kingston, Ont, Canada, on Dr H T Gussow, Dominion Botanist and Chief of the Phytopathological Service of the Dominion of Canada Dr Gussow has also been honoured by being elected a fellow of the Royal Society of Canada

Prof C H Desch has been appointed superintendent of the Metallurgy Department of the National Physical Laboratory, in succession to Dr W Rosenhain Prof Desch is at present professor of metallurgy, and Dean of the Faculty, in the University of Sheffield, and was formerly professor of metallurgy in the Royal Technical College, Glasgow He is a past president of the Faraday Society and of Section B (Chemistry) of the British Association Prof Desch will not take up his new appointment until February 1932, as he had previously accepted an invitation from Cornell University to give a course of lectures there during the winter session of 1931–32

The following appointments have recently been made by the Governing Body to the staff of the Lister Institute of Preventive Medicine Dr A Felix (research fellow in bacteriology), to be assistant in the Department of Bacteriology, Dr J M Gulland (University demonstrator in chemistry at the University of Oxford), to be first assistant in the Department of Biochemistry in succession to Dr R Robison, who became head of the department on Jan 1 last, Marjorie G Macfarlane (Carnegie research fellow), to be temporary assistant in the Department of Biochemistry, and Adèle H Rosenheim (Grocers' Company research student), attached to the same department, Douglas McClean (research fellow in bacteriology), to be assistant bacteriologist in the Department for the Preparation and Study of Antitoxic Sêra, Elstree, Hester M Jackson, to be temporary assistant in the Division of Nutrition, Dr G P Wright, to be research fellow in experimental pathology

We have received from Messrs James Swift and Son, Ltd, 81 Tottenham Court Road, W 1, their new catalogues of petrological microscopes and accessories for the petrological microscope The former lists instruments of varying degrees of complexity, from the 'Primex' designed to meet the requirements of the student to the 'Dick' and 'Graham-Dick' instruments adapted to the needs of the advanced worker. In all the models, the fine adjustment with single milled head at the back has been retained, but one actuated by lateral milled heads will be supplied if desired A stereoscopic binocular

on the Stephenson principle is also in the catalogue Of accessories, we note a series of micrometers and Shand's recording micrometer, goniometers of various types and complexity, and drawing and illuminating apparatus

A LIST (No 16) of nearly 600 second hand books of zoological, botanical, and horticultural interest has just been issued by Mr J H Knowles, 92 Solon Road, S W 2

A SHORT list (" Periodica ", Supplement 1) of scientific periodicals offered for sale by W Dawson and Sons, Ltd , Pilgrim Street, E C 4, has just reached us It should be of interest to anyone wishing to add to their scientific library or to complete imperfect sets of periodicals

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A technical administrative officer under the Leeds Education Committee, for secondary and higher education—The Director of Education, Calverley Street, Leeds (June 10) A lecturer in the department of building of the Birmingham Central Technical College - The Principal, Central Technical College, Birmingham (June 12) A full time teacher of electrical engineering subjects and chemistry at the Kingston upon Thames Junior Technical School—The Principal Technical College, Kingston upon Thames (June 13) A head of the boot and shoe department of the County Technical College, Stafford—The Clerk to the Governors, County Education Offices, Stafford (June 20) A head of the department of industrial administration of the Manchester Municipal College of Technology —The Registrar, College of Technology, Manchester (June 22) A headmaster of the Exeter Junior Technical School—The Secretary for Education, 39 Southernhay West, Exeter (June 22) A temporary principal technical assistant in the Shellfish Services staff of the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (June 22) A lecturer in economics in the Durham Colleges—The Secretary to the Council of the Durham Colleges, 38 North Bailey, Durham (June 23) Assistant lecturers in geology and mathematics in the University of Sheffield—The Registrar, University, Sheffield (June 24) A gas research Radiation, Ltd follow, at the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S W 7 (June 26) Junior lecturers in, respectively vertebrate embryology and cytology in the University of Edinburgh—The Secretary to the University, Edinburgh (June 26) A laboratory steward in the physics department of the Imperial College of Science and Technology—The Secretary, Imperial College of Science and Technology, South Kensington, S W 7 (June 30) A research student in biochemistry at the Lister Institute—The Secretary, Lister Institute Chelsea Bridge Road, S W 1 (July 1) A lecturer in chemistry and botany at the Studley Horticultural and Agricultural College for Women- The Principal Studley College, Warwickshire A young master for science and mathematics at the Beacon Hill School—Bertrand and Dora Russell, Harting, Petersfield A senior science master at St Lawrence College, Ramsgate—The Headmaster, St Lawrence College, Ramsgate

Our Astronomical Column

Calendar Reform - The *Scientific American* for June contains an article by G Eastman strongly advocating the adoption of a year of thirteen months with 28 days in each, and an extra day at the end, not to reckon as a weekday , in leap year there would be a second extra day, which would be placed at the end of the sixth month , each month would always begin with a Sunday There is no question that such a calendar would be convenient to such astronomers as have occasion frequently to reckon the interval in days between given dates , the want of system in the lengths of our present months, and the position of the leap day at the end of the second month, instead of the end of the year, are serious drawbacks But the interruption of the regular sequence of weeks, which have now been running without a break for some three thousand years, excites the antagonism of a number of people Some of these (the Jews, and also many Christians) accept the week as of divine institution, with which it is unlawful to tamper ; others, without these scruples, still feel that it is useful to maintain a time-unit that, unlike all others, has proceeded in an absolutely invariable manner since what may be called the dawn of history This view found strong support at the meeting of the International Astronomical Union at Rome in 1922 , and it is unlikely that there will be, at least in the near future, sufficient consensus of opinion to enable the scheme described above to be carried through

Mr. Eastman outlines a second scheme, which does not interfere with the week , this makes an ordinary year exactly 52 weeks, and inserts an extra week every fifth year (with occasional variations akin to the Gregorian centennial year regulations) The fact of making some years a week longer than others would however, involve difficulties in the regulation of salaries the variation of the equinoxes and solstices by a week would also give trouble in meteorology

To sum up every scheme involves so many controversial points that it is unlikely that any change will be made unless the calendar reformers confine their demands to more moderate limits

Light Variation of ε Aurigæ - This star is of special interest from the great length of its eclipses (assuming, as is usually done, that the light variation arises in this manner) *Astr Nach* 5784 contains a series of observations made at Bologna Observatory by Dr L Jacchia The following are his dates for the phases beginning of eclipse, May 13, 1928 , beginning of stationary minimum, Oct 22, 1928 , middle of eclipse, April 25, 1929 , end of stationary minimum, Oct 25, 1929 , end of eclipse, April 15, 1930 The light-variation includes secondary waves, their presence being confirmed by M Gussow, using a photoelectric cell , as a result of them, the increase of light was slower than the decrease The mean magnitude at maximum is given as 3 23 , at minimum, 3 88 The extreme points on the light curve are 3 13 and 3 94 Five stars in Auriga and Perseus, of magnitudes between 2 72 and 4 78 (Harvard) were used as comparison stars

Research Items.

Roman Pottery Kilns in Yorkshire.—The investigation of a Roman pottery kiln site at Throlam Farm, near Holme on Spalding is recorded in the *Transactions* of the East Yorkshire Antiquarian Society, vol. 27, pt. 1, by Mr. T. Sheppard and Mr. P. Corder. The site is a mound, about a hundred feet in circumference and about six feet above ground level, consisting almost entirely of wood ash and sherds. Near the centre is a mass of puddled clay forming a mound 14 ft. by 7 ft., stratified into clearly marked layers by bands of black ash and sherds, representing successive occupations or reconstructions. On the west end of this are two roughly constructed kilns, 3 ft. 6 in. and 2 ft. 7 in. in diameter respectively, which were fed from the same stokehole. They were constructed on the oven floor of an earlier and larger kiln which was itself superimposed on another. This larger kiln has been almost completely preserved. It differs from the usual type of small Roman pottery kiln only in certain particulars. No pit was excavated, but a mass of puddled clay was dumped on the floor of the kiln, and from this the later kiln was fashioned. The floor was supported on pillars which divided the furnace into three. The pottery, with the single exception of a Samian sherd, is of the Yorkshire coast Signal Station type of the last part of the fourth century; but as the bulk of the pottery is earlier than that of Huntcliffe or Scarborough, the most probable date is the later half of the third century.

Blood Standards for Indians.—In the course of study of anæmia in the Bombay Presidency, it was realised that no normal standards for Indians are available with which pathological findings can be compared. Even accepted European standards are found to present considerable variations in different text-books. Major Sokhey and his assistants have therefore examined 121 healthy young Indian men and 101 women living in Bombay by approved methods and with specially standardised apparatus (Report of the Haffkine Institute for the year 1929, p. 26, Bombay, 1931). The following averages have been obtained:

	Men	Women
Red cell counts, millions per cubic mm.	5·11	4·47
Hæmoglobin—grams per 100 c.c. of blood	15·36	12·99
Volume of cells, c.c. per 100 c.c. of blood	41·72	36·27

Isolation of Sexes in Bird Movements.—In a short paper in the *Naturalist* (May 1931, p. 145), Noble Rollin is able to confirm the statement that as a rule female birds form the vanguard in migration, and that the males show a tendency to lag behind. The result is the more interesting because it has been found amongst birds in which the sexes cannot be determined by examination in the field. Birds were collected at random in the neighbourhood of South Shields and grouped themselves in a series of six common land birds and seven waders and sea birds, a mixed bag of migrants and partial migrants. The sex was determined by dissection. On the whole, the results revealed by the two sets of records are very consistent. It would appear that during late autumn (October and November) the stock of birds is predominantly female, whereas in the winter (December and January) it is predominantly male. The curve in which the results are expressed illustrates the instability of the bird population of an area during autumn and winter, and this is apparently due to sexual dimorphism in the migratory movement.

Golgi Bodies and Yolk.—Allahabad University Studies, vol. 6, pt. 2 (Science Section), 1930, contains contributions from the Departments of Zoology, Chemistry, Botany, and Mathematics. Five of the seven zoological papers are on the cytology of oogenesis respectively of tortoises, the gecko, *Pila* (apple snail), frogs and toads, and fishes. In the tortoise, "fatty yolk is formed directly and indirectly by Golgi bodies", while albuminous yolk is formed either "by direct metamorphosis of mitochondria into a yolk body" or by other activity of the mitochondria; nucleolar extrusions take no part in the formation of yolk. In the gecko the Golgi bodies 'appear to play no part whatever in vitellogenesis". In *Pila*, the Golgi bodies contribute directly or indirectly to the formation of fatty yolk spheres; later the mitochondria multiply rapidly, swell, and give rise to true yolk spheres by a process of direct metamorphosis. In the frogs and toads, the Golgi bodies appear to take part in the formation of fatty yolk, though whether by direct metamorphosis was not determined. The true yolk is formed by the metamorphosis of mitochondria. In the fifth paper is described the infiltration of Golgi bodies, either in "big lumps or as is more frequent, in the form of granular bodies", from the follicular epithelium through the zona radiata into the oocyte of the fishes *Saccobranchus fossilis* and *Ophicephalus punctatus*.

Hard Fibre Production within the Empire.—An interesting lecture upon this subject by Mr. Alfred Wigglesworth is reproduced in the *Journal* of the Royal Society of Arts, vol. 79, No. 4087, Mar. 20, with an abstract of the interesting discussion that followed the lecture. The hard fibres referred to occur in the leaves of monocotyledons, and for many purposes they are now being exploited, at the expense of the fibre from the inner fibrous bark of dicotyledonous plants such as flax and hemp. They include New Zealand flax, *Phormium tenax*, *Furcræa gigantea* (mainly exported from Mauritius), and *Agave cantala*. In every case, the successful introduction of such a hard fibre depends upon the development of methods for the separation of the comparatively small amount of fibre from the tough leafy tissues; and the rapid development in recent years of the hard fibre trade is very largely due to the success with which the problem of the large scale extraction of sisal fibre has been attacked. Sisal has long been cultivated in Mexico, but in 1836 Mr. Perrine transported suckers to Florida. From the Florida plants, by vegetative propagation practically the whole area now under sisal outside Mexico, in East Africa, Dutch East Indies, etc., has been supplied. Mr. Wigglesworth points out that there is ample room for scientific study of the breeding, cultivation, and methods of extraction, purification, and grading of all these fibres. One point of great interest is that the sisal fibre has a larger cell lumen than the Manila fibre (from *Musa textilis*) and Mr. Wigglesworth thinks that this explains why sisal absorbs more water—and more rapidly—than Manila fibre. The *Bulletin* of the Imperial Institute, vol. 29, No. 1, 1931, contains a report of the effect of sea-water on the strength and durability of sisal hemp in comparison with Manila. Three series of trials have been completed and the results afford clear evidence that East African sisal has satisfactory durability in sea water.

The Wilberforce Radium Occurrence.—Under this title, H. S. Spence and R. K. Carnochan have recently described the richest deposit of radium ore yet found

in Canada (Dept of Mines, Canada *Investigations of Mineral Resources and the Mining Industry, 1929*, Ottawa, 1930, pp 1 23) The ore consists of uraninite disseminated in large crystals and aggregates through strings and long miarolitic pockets of calcite and fluorite, with subsidiary apatite, occurring in a syenite pegmatite, which itself contains large pockets lined with felspar crystals The uraninite bearing 'lead' is considered to be at least 500 ft long by 5 12 ft wide Tests on a carload of ore showed that 1 gm of radium would be recoverable from the concentrates separated from 3422 tons of ore This result, and the development work carried out in the field, suggests that the occurrence has commercial possibilities An analysis by Ellsworth of the uraninite shows U_3O_8, 61 64 per cent, ThO_2 13 56 per cent, and PbO, 11 05 per cent, corresponding to an age of more than 1200 million years It is of interest to record that, according to reports recently published in Montreal, pitchblende deposits have been found at Echo Bay on Great Bear Lake, 750 miles by river navigation from the railhead at Waterways, Alberta

A Survey of Niagara Falls A phototopographical survey of Niagara Falls was carried out in 1927 by the Geological Survey of Canada, and is fully described by Mr W H Boyd in *Memoir* 164 of the Geological Survey Work on the American Fall was comparatively easy since, owing to the small volume of water, the rock crest is visible from end to end In the Horseshoe Fall, however, the central part is completely covered and offers no points of identification To overcome this difficulty, three cameras, one at each of three stations, were exposed simultaneously Thus the appearance of the water along the width of the crest was revealed at the same instant from each of three stations It was found to be easy to identify the same points of the water face in all the three photographs Thus the crest could be mapped Elevations along the crest line were also taken Details of the methods employed are given in a pamphlet accompanying the surveys

The Queen Maud Range, Antarctica —This huge faulted range of mountains at the south eastern end of the Ross Sea was discovered by R Amundsen in his march to the South Pole in 1911 He charted roughly only a limited area on a small scale, for his field of vision was naturally limited Amundsen's map appeared in his book "The South Pole" (1912) Admiral R E Byrd crossed the range to the west of Amundsen's route in his flight to the South Pole in 1929 From his height, the range of vision was considerable The survey material from his aerial photographs was amplified by Prof L M Gould's sledge journey along the base of the range From all the available data, the American Geographical Society has produced a contoured map of the Queen Maud Mountains on a scale of 1 500,000, which is about ten times the scale of Amundsen's map (*Geographical Review*, April 1931) Positions are fixed from three astronomically determined points at which wireless time signals were observed The map reveals three immense glaciers, named Amundsen, Thorne, and Leverett, comparable in nature with the Axel, Heiberg, and Liv glaciers of Amundsen and the Beardmore glacier of Shackleton It gives the trend of the Queen Maud Range a more easterly direction than Amundsen had observed and disposes of his Carmen Land The map is a valuable contribution to Antarctic cartography

An Exceptional Night Sky —Lord Rayleigh, in the May number of the *Proceedings* of the Royal Society, describes an unusual night sky which was watched by him at Terling (52° N) on Nov 8, 1929 The light was much the same in constitution as on ordinary nights, extending uniformly over the sky, but was very much brighter than usual, and of constant intensity over a period of hours Its spectrum seemed continuous, and the green auroral line (λ5577) was not definitely seen It was evidently of a totally different nature from the polar auroral light, and, confirming this distinction, the state of the earth's magnetism was steady The negative bands of nitrogen could not be searched for on this occasion, as they were outside the range of the spectroscope used, but Lord Rayleigh says that in his experience the most striking distinction between the ordinary night sky and the polar aurora is the absence of the bands from the former, a contrary conclusion has, however, been arrived at by Sommer, who finds that these bands are present in the normal night light at Gottingen Lord Rayleigh has remeasured the two unidentified lines (or band heads) in the night sky spectrum at λ4419 and λ4168

Recombination of Cæsium Ions —The information afforded by quantitative study of recombination of electrons and ions is of very great value in testing theories of many atomic processes, giving essentially the effective cross section of an atom or ion under various conditions An account of an investigation of the recombination of cæsium ions and electrons to form normal ($1\,^2S$) atoms of cæsium, given by C Boeckner in the February number of the Bureau of Standards *Journal of Research*, is of particular importance because it verifies the fact that the normal state of cæsium is anomalous in its behaviour, recombination into two of the excited states of cæsium ($2\,^2P$ and $3\,^2D$) takes place in the simple way which would be expected from the quantum theory of the hydrogen atom, whereas recombination into the more tightly bound $1\,^2S$ state follows an entirely different law The results were obtained by Mohler's method of measuring the intensity of the continuous recombination spectra which appear at the series limits, simultaneously with a probe wire analysis of electron velocities by Langmuir's method, and furnish incidentally a proof of the correctness of the current theory of exploring electrodes

Electrical Resistance of Moisture Films on Glazed Surfaces —In measuring the electrical resistance between two conductors separated by a mass of insulating material, it has long been known that the apparent value of the resistance depends on the humidity of the air and the previous history of the insulator It is usual to divide the current which flows between the two conductors into two components, one flowing through the insulator and the other through a film of moisture or other conducting material on the surface of the insulator In actual tests, the relative values of these two currents vary largely, since water, even when very pure conducts much better than ordinary insulators the surface leakage current may be many times greater than the component which flows through the solid insulator In a paper published in the March number of the *Journal of the Institution of Electrical Engineers*, G G Small, R J Brooksbank, and Prof W M Thornton discuss how the electrical resistance of moisture films on glazed surfaces varies with the resistance, temperature, and vapour pressure of the surrounding medium Their experiments show that there is a very sharply defined critical pressure above which the resistivity falls as the pressure rises, and below which they both fall together The drop of voltage down a string of insulators depends on the

surface resistance as well as the capacitance of the units When a steam jet is played on the string until there is a complete deposit of visible moisture, the voltage gradient becomes a straight line The potential to earth of the lower units is sometimes more than doubled Stabilising devices, therefore at the earthed end of the string of insulators may be more effective in preventing flashover on the string The experiments show that water films are deposited or adsorbed on glazed surfaces long before they are visible as dew

Ohm's Law for Electrolytes —Experiments made in 1927 by Wien on electrolytic conduction in fields of 30,000-300,000 volts per cm indicated an increase of conductivity with field strength, amounting to as much as 50 per cent These results have been interpreted in the light of the modern theory of strong electrolytes, by assuming that in the case of high ionic velocities there is no opportunity, or only a restricted opportunity, for the ion atmosphere of opposite sign to build up around the moving ion so that the retarding effect of this atmosphere, giving rise to a change of equivalent conductivity with dilution, is not fully exerted More recently, Wien has found the effect for field strengths so low as 3000 volts per cm These experiments show that Ohm s law is not valid for electrolytes over the entire range of voltages Although it would not be expected in the case of the low field strengths used in the Kohlrausch method of determining conductivities, a change of resistance with applied voltage has been reported by Parker In the April number of the *Journal of the American Chemical Society* Jones and Bollinger show that with low field strengths the voltage used is without effect on the measured resistance over a wide range of frequencies and of resistances, and with cells of widely varying design Ohm's law may, therefore, be regarded as valid for electrolytes under these conditions

The Nature of the Chemical Bond —Recent applications of quantum mechanics have led to an approximate calculation of the energy of formation and other properties of very simple molecules, such as H_2, and have provided a formal justification for the rules stated by G N Lewis in 1916 for the electron pair bond Linus Pauling, in the April number of the *Journal of the American Chemical Society*, extends these applications and supplements Lewis's rules for the electron pair bond by new rules which provide information regarding the relative strengths of bonds formed by different atoms, angles between bonds, free rotation or lack of rotation about bond axes, etc A detailed theory of the magnetic moments of molecules and complex ions is also developed, the value of μ being given by $2\sqrt{S(S+1)}$, where S is the total spin angular momentum, the moment being determined entirely by the number of unpaired electrons This relation, which does not apply to rare earth ions, makes it possible to decide from magnetic observations between electron pair bonds and ionic and ion dipole bonds for various complexes The tetrahedral carbon, nitrogen, and phosphorus atoms in appropriate compounds are reproduced, and the known results for rotation about single bonds (except when restricted by steric effects) and lack of rotation about double bonds follow Several examples of the determination of structure from a knowledge of the calculated angles between bonds are given On the theoretical side, special attention is directed to the effect of concentration of the bond eigenfunctions The type of bond formed by an atom is dependent on the ratio of bond energy to energy of penetration of the core When this ratio is small, the bond eigenfunctions are p eigenfunctions giving bonds at right angles to one another, but when it is large, new eigenfunctions especially adapted to bond formation can be constructed

Metallic Corrosion —Two papers communicated by Sir Harold Carpenter to the Royal Society, and published in the May number of the *Proceedings*, furnish a great deal of information about the mechanism of corrosion of metals The first, by U R Evans, L C Bannister, and S C Britton, is on the velocity of corrosion from the electrochemical point of view Currents flow between anodic and cathodic parts of corroding metals, and it has been shown that the currents measured are equivalent to the corrosion produced, the problem of corrosion speed being thus largely reduced to a study of the electrochemical factors which determine this current One of the important factors which enters is polarisation set up by the current, it occurs in most cases at the cathodic area, and is due to limitations in the rate of supply of oxygen When corrosion starts at a weak point in an invisible film covering the surface of a metal, the area being attacked changes until the current density over it is equal to a certain ' protective value ', which is the current density which will cause any incipient attack on a weak point within the area in question to lead to a precipitation of rust so close to the surface as to seal the defect, a principle made use of in the ' cathodic ' method of preventing corrosion The second paper, by G D Bengough, A R Lee, and F Wormell—the fourth of a series on the theory of metallic corrosion—is chiefly upon the effect of oxygen upon zinc immersed in potassium chloride solutions, and shows that the action cannot be completely explained by the difference in oxygen concentration which had been postulated in the ' differential aeration ' theory Zinc hydroxide plays an important part in the reactions, both in a thin film which adheres closely to the metal and is impervious to oxygen and zinc ions, but not to electrons, and in the loose masses which appear, and do not completely stop the passage of oxygen

The Protection of the Underwater Hulls of Ships — The possibility of producing a hard smooth surface on the underwater hulls of ships which would remain smooth has long been regarded as desirable, for such a surface would lead to a great economy in fuel This is one of many subjects touched upon in a paper on " Modern Developments in Ship Design ", by Dr J Tutin and A C Hardy, contained in the January number of the *Transactions* of the Institute of Marine Engineers The authors state that marine growths cannot in general attach themselves to hard surfaces such as glass, porcelain, and clean steel Is it too much, therefore, they asked, to expect modern chemical research to provide an anti corrosive composition with an ultra-hard surface? In a written communication, contained in the *Transactions*, P Jenkins, chief chemist to Messrs J Dampney and Co, Ltd, stated that he thought the theory that marine growths do not adhere to hard surfaces is doubtful, in the Hancock Museum, Newcastle, is a bottle encrusted with beautiful specimens of barnacles All paints and compositions have of necessity to contain oily matter to repel water, and such materials cannot be made very hard It is, therefore, too much to expect chemical research to find an ultra hard preservative for ships' hulls The only coating of this nature which can be applied to iron is vitreous enamel, and this is impracticable for the protection of ships Vitreous enamels are fused at high temperatures and are applicable to only relatively small objects They are also prone to chip off

Statistics of the Universities of Great Britain.

TO the Returns * from Universities and University Colleges for the academic year 1929–30 the University Grants Committee prefixes an introductory note which serves to bring up to date the quinquennial review issued by the Committee last year and commented on at some length in NATURE of Aug 2, 1930

The total number of full time students, of both sexes, which increased by 7 per cent in the preceding five years, shows a further increase (to 45 603) of nearly 3 per cent, whilst the proportion of women students, which declined during those years from 31 4 to 29 1 per cent, shows a further drop to 28 3 per cent The regional distribution of the increment registered in 1929–30 was England 914 (879 men), Wales 96 (108 men), Scotland 245 (251 men) It is pointed out in the Committee's note that the figures for 1929–30 are swollen by the admission of 232 students to two year courses of training as teachers at university colleges, at the special request of the Board of Education, in view of the projected raising of the school age

London has increased its lead as the university having the greatest number of full time students (9141) The next twelve in order, Cambridge, Glasgow, Oxford, Edinburgh, Wales, Manchester, Liverpool, Durham, Leeds, Birmingham, Aberdeen, Bristol, show no change in their relative positions in this respect All universities except Aberdeen and Reading show some increase

The number of full time students from homes outside the British Isles was 4573, being 10 per cent of the total and 4 per cent more than in the preceding year More than one third of these are from foreign countries, and the number of such foreign students tends to increase somewhat rapidly It increased by 26 per cent in the five years 1923–29, and by 9 per cent from 1928–29 to 1929–30 The corresponding increases in the numbers of students from countries in the British Empire beyond the British Isles were 14 per cent in the five years 1923–29 and only 1 3 per cent in the following year Why the pull of the home universities is waning in these countries while waxing in foreign countries is a question on which light could perhaps be thrown by the delegates who are to meet at Edinburgh in July in the fourth Congress of the Universities of the Empire The universities which have the largest numbers of students from countries within the Empire outside the British Isles are London (1060), Edinburgh (456), Cambridge (352), Oxford (296), Glasgow (177), and Manchester (79) In addition to full time students, there were 653 part time students whose homes were outside the British Isles but within the Empire, and 852 foreign part-time students

The distribution of the full time students among the various subject groups in 1929–30 was arts, 53 4 per cent, medicine, 19 1, pure science, 16 5, technology, 9 1, agriculture, 1 9 This shows but little variation from the preceding year's distribution The decline in the number of men medical students, which had been continuous since 1923 24, was arrested in 1928 29, when there was an increase of 205, which was followed by a further increase in 1929–30 of 310 The similar decline in the number of women medical students continued down to 1929–30, when there was a small increase, from 1108 to 1136

Full time advanced students numbered 2128, of whom 1763 were men, an increase of 46 (men 55) The greater number of these students were at work at Cambridge (355), University College, London (228), Imperial College of Science, London (227), King's College, London (123), London School of Economics (121), Oxford (172), and Edinburgh (133) Their distribution among the various subject groups was as follows mathematics and pure science, 42 4 per cent, arts, 39 2 per cent (35 per cent of the men and 58 per cent of the women), technology, 11 5 per cent, medicine, 4 7 per cent, agriculture, 2 2 per cent Chemistry, including applied chemistry and biochemistry, claimed 487 students, engineering 216, physics 140, botany 87 In addition to these full time students, 1683 part time students (1351 men and 332 women) were engaged in advanced work

A table showing the numbers of full time staffs employed in the teaching departments gives the following totals professors, 798, readers, assistant professors, and independent lecturers, 334, lecturers, 1147, assistant lecturers and demonstrators, 827, and others, 243 The number of lecturers is somewhat understated owing to the Oxford and Cambridge returns excluding lecturers holding no full time university appointment, many of whom actually devote their whole time to teaching Omitting Oxford and Cambridge, the table shows that for the instruction of every hundred full time students there were available, on an average, the following full time teachers professors, 2, readers, etc, 0 9, lecturers, 3 3, assistant lecturers and demonstrators, 2 1, and other teachers, 0 7—total, 9 Taking England alone, exclusive of Oxford and Cambridge, the ratio of full time teaching staff to full time students was 10 8 per cent, in London alone it was 9, in Wales 11, and in Scotland 5 7

Statements of income and expenditure show totals of £5,338,064 and £5,280,530 respectively Commenting on these accounts, the Committee observes that of the fifty two institutions included in the returns, only two or three show deficits representing any serious financial weakness

* University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1929–1930 Pp 22 (London H M Stationery Office, 1931) 1s 3d net

Second International Congress of the History of Science and Technology

MEN of science from all parts of the world who are interested in the history and evolution of their subjects will be meeting at the Second International Congress of the History of Science and Technology to be held in London on June 29–July 4 under the presidency of Dr Charles Singer The Congress is held under the auspices of the Comité International d'Histoire des Sciences, with the collaboration of the Comité International des Sciences Historiques, the Newcomen Society for the Study of the History of Engineering and Technology and the History of Science Society Inquiries concerning membership and meetings of the Congress should be addressed to one of the honorary secretaries, Mr H W Dickinson, or Mr Walter Adams, The Science Museum, South Kensington

The Government is showing great interest in the Congress The President of the Board of Education,

the Right Hon H B Lees Smith, will open the proceedings at the inaugural meeting on Monday, June 29, the Director of the Science Museum, Sir Henry Lyons has generously invited the Congress to make the Science Museum its headquarters throughout the week, and other Government departments, such as the Royal Botanic Gardens, Kew, the Royal Observatory, Greenwich, and the Natural History Museum, have offered hospitality to members of the Congress

Three vexed problems in scientific method will occupy the attention of members at the morning sessions on Tuesday, June 30, Thursday, July 2, and Friday, July 3 The first discussion will have as its general theme, "The Sciences as an Integral Part of General Historical Study" Prof Gino Loria of Genoa, will take the chair at this meeting Mr G N Clark, of Oxford, late editor of the *English Historical Review*, will open the discussion Among those who will take part are Profs A V Hill and A F Heath and Dr Dampier Whetham On the same morning a discussion will be held on the teaching of the history of science Prof Welch of Johns Hopkins University, will take the chair, and contributions have been promised from Profs Loria, Wolf, and Aldo Mieli, of Paris

The discussion on July 2 will be on the "Historical and Contemporary Inter relationship of the Physical and Biological Sciences" Prof William Ritter, of California, will take the chair, and opening papers have been promised by Prof J S Haldane, of Oxford, and Prof W H Welch, of Johns Hopkins Prof Baas Becking, of Leyden, Dr Joseph Needham, and Prof Lancelot Hogben will be among the speakers The final discussion (July 3) will be upon the "Inter dependence of Pure and Applied Science" Sir Henry Lyons will occupy the chair, and contributions are promised from Sir Napier Shaw, Profs F G Donnan and C H Desch Mr R V Vernon, of the Colonial Office and others

The United States will be well represented by delegates from the following institutions, among others Columbia University, Brown University, Providence, Yale University Rochester University, Bryn Mawr College, Colorado University, Clark University, Worcester, Smith College, Northampton Georgetown University, Boston University, Dartmouth College, Hanover, Michigan University, University of California, Bates College, Lewiston Pomona College, Claremont, Duke University, Durham, University of Cincinnati, State University of New Jersey, New York University, Massachusetts Institute of Technology, Goucher College Baltimore, Utah State Agricultural College, University of Minnesota, Haverford College, Ohio State University, Mount Holyoke College, The Harvard Railway and Locomotive Historical Society

Of other universities outside the British Isles, representatives have been appointed from Alberta, the Muslim University of Aligarh, Allahabad, Basel Berlin, Bombay, the Université libre of Brussels Calcutta, Cape Town, Dacca, Guatemala, Hamburg Hong Kong, Leyden, Lucknow, Università Cattolica of Milan, Montevideo, Madras, New Zealand, Nova Scotia, Oslo, Punjab Rangoon, Stellenbosch, Toronto, Tasmania, and a number of others Among other institutions that will be represented are the Gesellschaft fur die Geschichte der Naturwissenschaften of Berlin, the Institut fur Geschichte der Medizin und Naturwissenschaften of Leipzig, and the Kulturwissenschaftliche Bibliothek Warburg of Hamburg The Academy of Material Culture of Leningrad expects to send three representatives

A full programme has been arranged for the social entertainment of members and guests Receptions are to be given by the Royal Society, the Royal Society of Medicine, the Royal Institution, and the Institute of Historical Research Special excursions are to be made to the Universities of Oxford and Cambridge, which have offered hospitality to members of the Congress The Provost of University College London, will entertain members at an Independence Day luncheon on July 4 Special visits will be made to the Royal Botanic Gardens, Kew, the Royal Observatory, Greenwich, Barbers' Hall, and the Royal College of Physicians

A Ladies Committee, under the chairmanship of Mrs T F Tout, is arranging a programme of visits for ladies at the Congress who will not be attending the morning sessions

Water Power Developments in the United States

RETURNS which have recently been issued by the Geological Survey of the United States Department of the Interior (*Report* No 50,669) afford some interesting particulars of recent developments in the utilisation of the water power resources of the country Up to Jan 1, 1931 the total capacity of water wheels installed in water power plants of 100 horse power or more was nearly fifteen million (14,884,667) horse power, representing an increase of more than a million (1,076,889) horse power, or 7 2 per cent, during the year 1930 In an article in NATURE for April 18, the corresponding figures for Canada were shown to be 6,125,000 horse power and 397,850 horse power An estimate based on present practice in the installation of plant for the utilisation of water power indicates that about nineteen per cent of the available resources in the United States have been exploited, as compared with about fourteen per cent in Canada

This estimate, however, as also that in the case of Canada, though taking into account the results of the latest surveys and investigations, cannot be regarded as final In a number of the States, more particularly those in the south and centre, additional information is required before a definitely reliable figure can be arrived at A moiety of the available power of the Niagara River and of the international section of the St Lawrence River is included, though it is pointed out that an international agreement will be necessary in order to permit of the full development of these supplies

Washington comes first among the individual States in extent of potential supplies, and is followed fairly closely by California, Oregon, and New York A large proportion of the potential resources of the last named State is available continuously, as distinguished from the bulk of the supplies elsewhere, which are of an intermittent character This is due to the equalisation of the flow of the Niagara and St Lawrence Rivers The same remark applies to the States of Arizona and Nevada, where the resources are mainly on the Colorado River, the flow of which can be controlled

The 14,884,667 horse power realised to date in the whole of the Union is the product of 3344 individual installations of which nearly one half (1588), with a capacity of 13,108,830 horse power, are public utility and municipal undertakings, the remainder being devoted to manufacturing and miscellaneous purposes

Association of Teachers in Technical Institutions

THE twenty second annual conference of the Association of Teachers in Technical Institutions was held at Manchester during the Whitsuntide holiday On Whit Monday the Association was accorded an official welcome by Alderman F J West (ex-Lord Mayor of Manchester and a member of the Government Committee on Education for the Engineering Industry), Dr Stanley Hodgson (Chairman of Governors, Royal Technical College, Salford), and Alderman J Smith (Chairman of the Bury Education Committee) On the same day the retiring president, Mr H A Norman (of Bury), inducted the president for the coming year, Mr H Ade Clark, who delivered his presidential address

Those who expected Mr Clark to deal with the matter of salaries (notice has been given that the present scales of salary for technical teachers will be terminated on Mar 31, 1932) were disappointed He insisted that the question was one for the Association's representatives on the Burnham (Technical) Committee, and said that whatever the outcome of negotiations might be, the Association could not lose sight of the problems which it had to face in company with the Board of Education, the local education authorities, and those engaged in the country's industry and trade Those problems, he said, had been well summed up by one of his predecessors in office Mr A E Evans, in a paper to the last North of England Education Conference ' Soon after the War it became apparent that, hitherto unchallenged, or feebly challenged, commercial and industrial supremacy of Britain was likely to experience a fierce onslaught from other nations It was recognised by those engaged in our technical institutions that one of the weapons of defence would be a system of education which would provide men and women – whether as leaders or as led—who realised the potentialities of this country and its associated Commonwealth as one of the great manufacturing carrying, and exporting civilisations of to day To determine these potentialities and how best to educate men and women for their development was of vital importance "

With these points in mind Mr Clark surveyed the rapid developments of technical education, and, in indicating the Association's work in connexion therewith, he showed that it was not in Britain alone that the work of technical education was becoming recognised The Association was in touch with the Technical Instructors' Society of Australia, it was linked to the great American continent through the English Speaking Union its views had been sought and given to the World Conference of Education Associations at the Geneva meeting, and its representatives had formed part of the English delegation which attended last summer, the International Congress on Technical Education held at Liege under the auspices of the Belgian Government, when twenty two nations were represented

In spite of this development of national and international opinion, however, Mr Clark indicated the difficulties which technical education had still to face If a scientific approach were to be made towards the solution of our problems of education and industry, it was clear that a small national co ordinating committee would be necessary to bring together the information secured by local bodies which were forming machinery to draw together educationists and industrialists The Board of Education was not yet prepared to admit the necessity of such a committee

Frequently too, those responsible for local educational administration seemed, "like the tradition loving schoolmaster, unable to view problems except through academic spectacles They fear to face the implications of the changing needs of the kaleidoscopic industrial and commercial civilisation in which we live It rationalisation means the application of organised knowledge, the importance of technical education has to be realised by educationists as well as industrialists The latter are by no means the only people clinging to ancient methods and conceptions "

To show that those who may be powers in public life also needed convincing, Mr Clark referred to a recent speech of the Right Hon Sir Herbert Samuel M P, who said (as though to show the superiority of university to technical education) that although technical colleges may be useful and necessary non technical institutions gave something better Men, he said, are not content with obtaining the means of getting a living, they want to live, and the most powerful events of our time do not turn upon economic issues In such thinking, Mr Clark suggested, there is a lack of clarity "Does not a university provide technical education? What sort of doctors lawyers architects, would we have if it did not? And do technical colleges not teach the art of living? Is there any better way that such an art can be taught than by the relationships of men (social industrial and commercial) made through the work they have to perform in the world? Where would our art of living be without our engineering our chemistry our building, and our domestic science? And is there any art or ideal or joy that is not ultimately dependent on economic issues?"

Among the resolutions dealt with by the Conference was one asking for a review of the conditions of entry into various branches of industry It stressed the desirability of remission of some period of apprenticeship for ex full time pupils of senior and junior technical schools, the need for an extended provision of opportunity for all entrants into industry to pass into the ranks of skilled workers and the need for further provision of part time day courses for apprentices and learners Considerable discussion was also centred upon a resolution which included a declaration that a knowledge of biology is part of a sound general education, and that more experts are needed in biological subjects for the proper development of agriculture and industry

In connexion with the Conference an excellent exhibition of books and apparatus was provided by a number of publishers and apparatus manufacturers

Organisation of a Locust Campaign

THE locusts constitute one of the oldest known plagues of agriculture, but the efforts to study them have always been sporadic and local, while the problem is a very wide one It is very gratifying to learn, therefore, that the Empire Marketing Board, acting on the recommendations of the Committee on Locust Control of the Economic Advisory Council, has made a grant of £2720 towards the organisation of exhaustive investigations on locusts The grant represents one half of the estimated cost of investigations during the first year, the other half being covered by contributions from the various British territories participating in the scheme

The investigations are being conducted by the

Imperial Institute of Entomology, where a special section has been formed for the collection and summarising of all the available information on locusts Regular reports on the appearance and movements of locusts are being received in the Institute, where they are analysed and correlated so that a clear picture of the situation is obtained and deductions can be drawn as to the possible source of each invasion Data of this kind make it possible to draw conclusions as to which areas can be suspected as the probable permanent breeding grounds of locusts

At present the Red Sea littoral of Africa, the northern provinces of Kenya, and certain areas in Arabia are marked down as deserving a close investigation, and two field entomologists will be sent shortly to the Sudan, and one to Kenya, to study the conditions on the spot It is hoped that the field entomologists will be able not only to locate the breeding areas but also to study the natural conditions which make them favourable for locust breeding Thus, the first year's programme of work consists mainly of a preliminary ecological survey of the breeding areas The whole scheme is planned to cover a period of five years, and it is proposed to establish a field laboratory for studying locust bionomics on the spot and for experimenting on natural factors which may be responsible for controlling locusts or encouraging their multiplication and the transformation into the swarming phase Knowledge of this kind would make it possible to suggest methods for preventing outbreaks or at least to forecast outbreaks, which alone would mean an enormous saving

The investigations were proposed originally to include only British territories, but lately certain foreign governments have expressed their readiness to co operate in the scheme Such a concerted attack on the locust problem has never been attempted before, and valuable results can confidently be expected

University and Educational Intelligence

CAMBRIDGE — The report of the General Board in connexion with the scheme for the employment of the Rockefeller Endowment for Scientific Departments recommends that the following posts be established as from Oct 1 a University lectureship in cytology in the Department of Agriculture a University lectureship in plant physiology and a University lectureship in mycology in the Department of Botany an additional University lectureship and an additional University demonstratorship in the Department of Biochemistry

In a series of reports the General Board recommends that readerships in the University should be created for the following Mr F T Brooks, of Emmanuel College, in mycology, Dr A D Imms, of Christ's College, in entomology, and Mr James Gray, of King's College, in experimental zoology The following posts will also be created a curatorship of the Sedgwick Museum in the Department of Geology, a senior curatorship and a junior curatorship of the Museum of Zoology

At Clare College, Dr H Godwin, research fellow of the College and University demonstrator in botany, has been appointed to an official fellowship At Trinity College the following have been elected to research scholarships J C Jaeger in mathematics, W G Thompson in physics, E F Warburg in botany, and P Ullyott in zoology

EDINBURGH Dr Walter Smith Kay, who died on April 22, has bequeathed to the University the sum of £5000, subject to Government duty, the annual income to be applied towards aiding research in mental diseases or psychiatry in such manner as the University Court and the professor of psychiatry shall think fit

The Senatus has intimated that Prof Sydney Smith is appointed dean of the Faculty of Medicine, in succession to Prof Lorrain Smith, who died on April 18

LONDON —Dr C R Harington (pathological chemistry) has had the title of professor conferred on him in respect of his post at University College Hospital Medical School, Mr James Fairgrieve (education, with special reference to methods of teaching geography) has been appointed reader in respect of the post held by him at the London Day Training College, and Dr R C J Howland (mathematics) has been appointed reader in respect of the post held by him at University College

The title of emeritus professor of experimental pathology in the University has been conferred on Sir Charles Martin, and that of emeritus professor of biochemistry in the University on Dr Arthur Harden on their retirement from the Lister Institute of Preventive Medicine

OXFORD — In view of certain statements in the Report of the Library Commission, by which it appears to be contemplated that the part of the Old Ashmolean Museum at present occupied by those engaged on the Oxford English Dictionary shall be "retained as a first provision for large co operative enterprises" such as the Dictionary of National Biography, the Association of Friends of the Old Ashmolean, at its annual meeting held on May 29, adopted a resolution strongly advocating the restoration of this historic building to scientific purposes akin to those for which it was originally founded At the same meeting it was pointed out that there is still a confusion in the minds of many persons as to the relations existing between the two museums known as the "Ashmolean" and "Old Ashmolean" respectively The Ashmolean Museum exists for the purpose of illustrating art and archæology, whereas the Old Ashmolean was intended for scientific studies, and has been intimately associated with the natural sciences ever since 1683

THE Scientific Club of Winnipeg has awarded its Research Prize of 250 dollars, for the most meritorious investigations conducted by a post graduate student in the University of Manitoba during the last three years, to Dr P A Macdonald The researches of Dr Macdonald, which were carried out in the Department of Physics, consisted of studies of the senses of temperature, pain, vision, touch, and hearing, with particular reference, in the last three, to the validity of the Weber Fechner law

A NUMBER of studentships in relation to cotton growing, not exceeding eight in all, will be awarded in June next by the Empire Cotton Growing Corporation They will be of two kinds, namely, specialist studentships and agricultural studentships The first named are intended to enable graduates, who believe that they have a leaning towards research, to equip themselves for posts in which work of that type is required Successful candidates will, in general, be required to take a course in agriculture during the tenure of their studentship if they do not possess an adequate knowledge of the subject The Agricultural Studentships are intended to enable men to receive such specialised instruction as their previous qualifications and experience show to be most desirable in order to equip them for agricultural posts in cotton growing countries wherever opportunities for employment may present themselves, whether in government agricultural departments, with commercial cotton growing companies, or under the Cotton Growing Corporation Forms of application, returnable by, at latest, June 10, can be obtained from the Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, S W 1

Birthdays and Research Centres.

une 7, 1877.—Prof. C. G. BARKLA, F.R.S., professor of natural philosophy in the University of Edinburgh.

The *J* phenomenon still engages our attention on account of its seemingly fundamental nature. Experimental results 'cut right across' current theory and indicate that some properties of radiation (at least) are controlled not by independent constituent wave trains or quanta but by a quality of the whole stream of radiation more closely allied to temperature. Some elusive condition is, however, essential to the occurrence of the *J*-discontinuities—a condition found to be independent of the nature and disposition of apparatus so far as these are externally observable. Recent experiments with Mr. Honeyman show the rapid development of the characteristic discontinuities with the time of exposure of the radiating substance to X-rays; while experiments with Mr. Kay confirm and extend this conclusion by showing that two different specimens of one kind of radiating substance behave differently at the same time, one providing discontinuities, the other not. Our immediate problem is to discover the nature of this critical state of the radiating substance.

June 11, 1867.—Prof. CH. FABRY, professor of physics in the University of Paris.

Nous connaissons assez bien la partie basse de notre atmosphère, celle qui nous est directement accessible. Mais au dessus, entre la basse atmosphère et les espaces cosmiques, s'étend une région étendue, qui fait encore partie de la terre puisqu'elle gravite avec elle, et dont l'étude est très difficile. Cette étude est cependant fort importante; ce sont ces hautes couches de notre atmosphère qui reçoivent tous les chocs venant de l'extérieur: Étoiles filantes et bolides, corpuscules électriques (rayons cathodiques et rayons positifs), radiations de toutes longueurs d'onde. Ce que l'on sait sur ces hautes couches a été trouvé un peu par hasard; c'est ainsi que l'étude pratiqué des communications par radio a fait connaître l'existence de hautes couches renfermant un nombre important de charges électriques.

L'étude de l'absorption des radiations venant des astres, en particulier du soleil, dans leur passage à travers notre atmosphère, a révélé aussi des choses très inattendues. Il y a, dans la partie haute de notre atmosphère, une certaine quantité d'ozone, qui absorbe une grande partie des radiations ultra-violettes venant du soleil. Des résultats fort importants ont déjà été obtenus, en particulier par Dobson et ses collaborateurs; l'étude demande à être poursuivie. Des recherches récentes (Buisson, Ladenburg et Götz) ont confirmé que la basse atmosphère contient un peu d'ozone; il faut en tenir compte dans les études sur l'absorption. L'altitude de la principale couche d'ozone de la haute atmosphère a été, jusqu'ici, évaluée à 50 km environ; si l'on tient compte de l'ozone de la basse atmosphère, on sera probablement amené à placer encore plus haut l'ozone de la haute atmosphère, peut être à 80-100 km (Chalonge). Cet ozone est peut être en relation avec la couche ionisée que révèlent les observations sur la radio.

Les expériences récentes poursuivies dans divers pays sur les *fusées* donnent l'espoir que l'on pourra un jour envoyer des instruments dans ces très hautes régions.

Societies and Academies.

LONDON

Royal Meteorological Society, May 20.—Sir Gilbert Walker: Recent work by S. Mal on the forms of stratified clouds. Two years ago it had been suggested that the breaking up of a stratum of cloud into polygons or long strips was often due to instability, accompanied in the latter case by shear parallel to the strips. Mal showed that a rectangular pattern was caused when the unstable stratum was subjected to a less rapid shear than is needed for strips; and verified from measurements made in the sky that cloud strata break up or persist according as their temperature gradient is unstable or stable; and that when they break up the pattern assumed is polygonal, rectangular, or in strips according as the shear is zero, moderate, or large.—**C. K. M. Douglas**: A problem of the general circulation. So far as can be judged from present data, there is no appreciable net flow of polar air in the lower troposphere towards the subtropical anticyclone. This supports the view of Dr. Jeffreys, namely, that the exchange of air between different latitudes, required to maintain the angular momentum of the zone of west winds against friction, is carried out entirely by currents lying side by side, and not one above the other. The fundamental problem is the relation of the individual cyclone to the general circulation, and this has not yet been solved.—**G. S. P. Heywood**: Wind structure near the ground, and its relation to temperature gradient. The wind velocities were obtained by two anemometers at heights of 12·7 m. and 94·5 m. above the ground. There are not many results from anemometers so high as 95 m.; for this reason, the ordinary diurnal variation at this height in summer and winter is shown, with that at 13 m. for comparison. The vertical gradient of temperature up to 87 m. is also recorded. Wind gradient must depend largely on temperature gradient, and the relation between the difference in wind velocity and the difference in temperature over approximately the same height interval, is worked out for various wind strengths.

PARIS

Academy of Sciences, April 20.—The president announced the death of René Kœhler, *Correspondant* for the section of anatomy and zoology.—**M. Delépine**: Notice on Raffaello Nasini.—**L. Joubin**: Notice on René Kœhler.—**Lucien Daniel**: The persistence and accentuation of variations in the descendants of the Jerusalem artichoke grafted on the sunflower. In agreement with the hypotheses of Lamarck and Darwin, it has been proved by a series of experiments started in 1894 that grafting in the Jerusalem artichoke and its descendants is a powerful factor of variation, the action of which persists and is sometimes accentuated in the successive generations of this species.—**W. Tartakowsky**: The representation of a system of numbers by a system of positive additive quadratic forms.—**S. Carrus**: The integration, without the sign of quadrature, of certain systems of differential equations with any coefficients.—**Mlle. Marie Charpentier**: Semi-closed ensembles and their applications in the theory of Peano points.—**E. Kogbetliantz**: Jacobi developments.—**N. Abramesco**: The movement of a variable plane figure with conservation of similitude.—**Alfred Rosenblatt**: The plane movements of viscous liquids adjoining radial movements.—**Paul Woog, Mlle. Emilie Ganster,** and **Jean Givaudon**: The stabilisation of oils for chronometry. Fatty oils as lubricants for clocks and watches have advantages over mineral oils, but have the dis-

advantage that the viscosity changes owing to oxidation Experiments on various anti oxygens, based on the work of Moureu and Dufraisse, have led the authors to propose a mixture of β naphthol and a red dyestuff to be added to the oil The former prevents oxidation, and the dye by absorbing the actinic rays hinders oxidation due to exposure to daylight — **G A Mokrzycki** Determination of the combustible necessary to reach the practical plafond — **G Reboul** Singularities presented by bodies submitted to the action of resistance cells **Th V Ionescu** Ionised gases and Coulomb's law The existence of a vibration period for ionised gases makes possible the calculation of the velocity of propagation of an electric wave in these media —**Mlle Paule Collet** and **G Foex** The magnetic states of platinum —**V Lalan** The hypothesis of the curve of pursuit and refraction in optical systems in motion —**H Hulubei** and **Mlle Y Cauchois** A simple and luminous arrangement for the study of the Raman effect —**Jean Becquerel** and **Louis Matout** A new magneto optical effect rotatory power along the optical axis of certain uniaxial crystals in the neighbourhood of absorption bands under the action of a magnetic field normal to this axis —**S Rosenblum** and **M Valladares** Figures of distribution of the active deposit on electrodes — **Georges Fournier** The existence of different isotopes A list is given of probable isotopes not so far found experimentally —**René Pallu** The decomposition of monobarium phosphate in solution — **Georges Arditti** The oxidation of paraffin oil by air For the detection of the first traces of acid formed by the oxidation, use is made of Dubrisay's method of the change in the interfacial tension between the oil and a solution of caustic soda At temperatures of 15 C and 85 C there is no oxidation, but traces of acid appear at 110 C —**P Bary** and **E Fleurent** The law of degradation of solutions of rubber as a function of the time at different temperatures —**P Laffitte** and **M Patry** The transmission of a detonation at a distance **M Paic** The double compounds between the mercuric sulphates and mercuric iodide **J Bougault** and **G Schuster** A new triglyceride obtained from cocoa butter A palmitostearoazelain —**M Tiffeneau, Mlle Jeanne Lévy,** and **E Ditz** Two diastereoisomeric derivatives of campholenic acid their formation in unequal but inverse proportions by inverting the order of introduction of the fixed radicals — **R Cornubert** An attempt at the reproduction of a tetrahydropyrone compound —**Charles Dufraisse** and **Roger Netter** Researches on the ethylenic ketones α bromo β aminobenzalacetophenones —**Marcel Godchot** and **Mlle Germaine Cauquil** Some new derivatives of the cyclo octane series A new cyclo octene oxide is described, as well as the glycol obtained by its hydration — **R Paul** The action of magnesium on some halogen substituted ether oxides The reaction between magnesium and oxides of the type $RO(CH_2)_3X$ ($X = I$, Br, or Cl) has been studied The reaction is influenced both by the catalyst added and by the nature of the solvent —**Paul Gaubert** The artificial coloration of crystals of oxalate and nitrate of urea A study of the influence of various colouring matters on the crystalline forms of urea oxalate and urea nitrate —**F Zambonini** and **V Caglioti** New researches on the chemical composition of sarcolite from Mont Somma (Vesuvius) Five complete analyses are given these are not in agreement with the formula proposed by Gossner and Mussgnug —**Yang Kieh** The dislocated zone situated to the north of the Chaîne de la Marche **V Frolow** The periodicities of the risings of the Niger at Koulikoro The results of the study by the method of A Wallen of 24 years' data —**R Bureau** The variations of wireless atmospherics during the eclipse of the moon of April 2, 1931 The curves of the records of atmospherics recorded at Saint Cyr and at Mont Valérien show a marked anomaly between 18 h and 24 h on April 2, 1931 Hence there is a connexion between the eclipse of the moon and atmospherics —**Jean Chevrier** Magnetic exploration in Syria —**P L Mercanton** The inversion of the magnetic inclination in geological time New observations In an earlier communication, a study of the natural magnetisation of volcanic lavas of various origins (Greenland, Spitsbergen, Australia) led to the conclusion that at the Tertiary epoch, at the time of the great volcanic outbursts, the terrestrial magnetic inclination was, in both hemispheres, the reverse of what it is to day Further experimental data in support of this view are now given —**F Labrousse** The changes in reaction observed in the course of the development of some fungi The influence of the nature of the nitrogenous food material —**E Wollman** and **V Uribe** Researches on humoral immunity in cold blooded animals —**Maurice Nicloux** The micro estimation of organic substances in dilute solutions by sulphochromic oxidation Special application to the micro estimation of ethyl alcohol —**Delherm** and **Laquerrière** A new apparatus for faradic currents

ROME

Royal National Academy of the Lincei, Nov 2 —**F Vercelli** Complementary observations to the note on a general method for the analysis of the periodicity in statistical and experimental diagrams **C Carathéodory** Canonical transformations of slipping and their application to geometrical optics —**R Nasini** Discovery of boric acid in the glaze of the vases of Arezzo The glaze of these vessels, which constitute one of the finest examples of the Roman art of the first century B C and the first A D contains boric acid, not in accidental traces, but as a definite component (see NATURE, Dec 6, p 877) —**S Amante** Matrices which satisfy a given algebraic equation —**B de Finetti** Determinate and indeterminate problems in the calculus of probabilities —**Maria Pastori** Isotropic tensors relation between the components **Margherita Piazzolla-Beloch** Connected oblique multilaterals —**E Čech** A demonstration of Jordan's theorem **A Kolmogoroff** The conception of the mean —**Nikola Obrechkoff** A generalisation of Cesàro's summation —**G Rabaté** Some points of direct infinitesimal geometry Investigations on the notions of contingent and paratingent used by G Bouligand as instruments of his direct infinitesimal geometry are summarised — **E Gugino** The extension of Morera's theorem to the motion of systems with reversible linkings —**L Poggi** Extension of D'Alembert's paradox and of the Kutta Joukowski theorem to circular arc profiles —**E Pistolesi** The dynamic actions of a circulatory current on cusped profiles —**A Signorini** The mechanics of continuous systems In dealing with any problem of finite deformations, it is convenient, in the first place, to subject the general equations of the mechanics of continuous systems to a transformation analogous to that which, in the particular case of hydrodynamics, leads from Euler's equations to those of Lagrange A new Lagrangian form of the indefinite equations now given may be of use in the indirect solution of certain particular problems —**Angelina Cabras** The mechanics of rigid bodies in generalised spaces A scheme of procedure for applying the methods described in a preceding note to the static and dynamic treatments to all elliptical S_n is given —**Enrico Volterra** The general laws of the vibrations

of a network of stretched elastic wires with nodes in common and fixed or vibrating extremities are considered, the initial configuration of the system and the initial velocities of the elements of the elastic elements of the system being assumed known The application of such laws to the study of water hammer in a network of pipes under pressure is described — **R Bilancini** The coefficient of correlation An examination is made of the coefficient of correlation in the case when the relation between the two magnitudes considered is not linear, but when one of the magnitudes is expressible by means of a polynomial of the other of degree n, greater than one **E Fermi** Quantistic electrodynamics (2) The quantistic forms recently derived for the equations of a system composed of an electromagnetic field and of any number of point electric charges referred to the non relativistic case the velocity of the charges being not very high These are now converted into the relativistic forms by a method other than that based on Dirac's theory of the rotating electron — **G B Pacella** Simple method for the calculation of an aspherical plano convex lens The form to be assigned to an aspherical lens with one plane face in order that it may be stigmatic for the point on the axis at infinity when a beam of monochromatic light falls on it is determined **A Masotti** Calculation of the resultant and of the resultant moment of the electrostatic pressures in a plane field by formulæ analogous to the hydrodynamical formulæ of Blasius The analogy between the electrostatic pressures exerted on the surface of an electrified conductor in equilibrium and the hydrodynamic pressures of a liquid in permanent irrotational motion on the surface of an immersed solid, is developed It is shown that for an indefinite cylindrical conductor in an electric field with distribution uniform to infinity the resultant of the electrostatic pressures on unit length of the conductor has the direction and sense of the electric force at infinity, while its magnitude is the product of such force by the charge of unit length of the conductor ; the system of electrostatic pressures is equivalent to the resultant applied at the barycentre of the charges —**A Corbellini** and **L Barbaro** The anomalous decomposition of the tetrazo derivative of 2 2 diamino 1 1′ dinaphthyl The acid melting at 250 252 , previously observed is a product of this decomposition, is formed by partial decomposition of the tetrazo compound when acid solutions of its sulphate or chloride are heated This reaction proceeds also, although very slowly, at the ordinary temperature, and yields in addition, neutral compounds difficult to purify - **Morello Morelli** Spectrochemistry of solutions of boric acid in glycerin The molecular and specific refractivities of boric acid in glycerin solution are greater than in aqueous solution, and decrease as the concentration of the solution is increased Dissolution of boric acid in glycerin is accompanied by expansion, the extent of which increases markedly with the concentration — **F Rodolico** Polyhedric pisolites of magnesite and of dolomite - **G Mezzadroli** and **E Vareton** Action of ultra short electromagnetic waves ($\lambda = 2\ 3$ m) on silkworms (3) Irradiation of the eggs The favourable effect of the waves is increased if the exposure is commenced prior to hatching of the eggs —**M Fedele** Innervation and peripheral sensitive arrangements of the arterial trunk of reptiles **S Ranzi** Conditions determining the development of gills (investigations on the experimental embryology of cephalopods) —**M Mitolo** Oxygen and central nervous functions One of the mechanisms which explain the action of oxygen in the functions of the central nervous system and the indispensability of this gas to the central nervous elements is the continuous oxidation of acids occurring among the metabolic products of this system **Clara Forti** Excision of the vessels and nerves of the ovary, total or partial excision and metabolism (3) This excision produces slight retardation of the metabolism during the first few months after the operation

Official Publications Received

BRITISH.

Rhodesia Museum Bulawayo Twenty ninth Annual Report, 1930 Pp 12 (Bulawayo)

Proceedings of the Royal Society Series A, Vol 131 No A817, May 1 Pp 276 517 (London Harrison and Sons, Ltd) 12s

The Proceedings of the Physical Society Vol 43 Part 3 No 238, May 1 Pp viii+227 370 (London) 7s net

Amgueddfa Genedlaethol Cymru National Museum of Wales Welsh Timber Trees, Native and Introduced By H A Hyde Pp viii+107 +25 plates (Cardiff) 1s

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31, 1930 (No 2269) Pp v+41 (Ottawa F A Acland) 25 cents

Canada Department of Mines Geological Survey Memoir 164 The Niagara Falls Survey of 1927 By W H Boyd (No 2246) Pp ii+16+ 5 plates 10 cents Summary Report 1929 Part B (No 2255) Pp 202B (Ottawa F A Acland)

Canada Department of Mines Mines Branch Investigations of Mineral Resources and the Mining Industry 1929 (No 719) Pp 69+ 5 plates (Ottawa F A Acland)

Publications of the Dominion Astrophysical Observatory Vol 4, No 19 Four Spectroscopic Binary Orbits By W E Harper Pp 309 323 +1 plate 25 cents Vol 4 No 20 The Galactic Rotation Effect in some Late Type Stars By R O Redman Pp 325 340 25 cents Vol 4 No 21 Y Cygni By R O Redman Pp 341 350+1 plate 25 cents (Ottawa F A Acland)

Trinidad and Tobago Minutes and Proceedings of the Froghopper Investigation Committee Part 20 Pp 193 268 (Trinidad Government Printing Office Port of Spain)

Journal of the Royal Statistical Society New Series Vol 94 Part 2 Pp 171 358+xvi (London) 7s 6d

The Transactions of the East Riding Antiquarian Society Vol 27, Part 1 Pp iv+80+8 plates (Hull The Museum) 10s 6d

Imperial Bureau of Fruit Production Horticultural Abstracts Vol 1, No 1 March Pp 24 (East Malling) 1s 6d

Report of the National Park Committee (Cmd 3851) Pp 131 (London H M Stationery Office) 2s net

Department of the Interior Canada Topographical Survey Bulletin No 63 The Aneroid Barometer and Altimeter their Characteristics and Use in Mapping By R H Field With an Appendix The Field Use of the Aneroid Barometer by G C Cowper Pp 36 (Ottawa F A Acland) 10 cents

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1363 (Ae 491 -T 2977 and a) Maximum Lift in Closed and Open Jet Tunnels By F B Bradfield, K W Clark and R A Fairthorne Pp 19+5 plates 1 net No 1278 (Ae 424—T 2928 Spin 8) Spinning Experiments on a Single Seater Fighter Part 1 Further Model Experiments by A S Batson and H B Irving Part 2 Full Scale Spinning Tests by S B Gates Pp 10+12 plates 9d net No 1363 (Ae 484—T 2984) The Two Dimensional Flow of Air around an Aerofoil of Symmetrical Section By T Tanner Pp 11+18 plates 1s net No 1368 (Ae 487—T 2969) Spinning of a Model of the Fairey IIIF Seaplane By H B Irving and A S Batson Pp 15+27 plates 1s net (London H M Stationery Office)

FOREIGN

Zoologica Scientific Contributions of the New York Zoological Society Vol 9, No 12 The Fur Seal of the California Islands with new Descriptive and Historical Matter By Charles Haskins Townsend Pp 443 457 (New York City)

Scientific Publications of the Cleveland Museum of Natural History Vol 1 No 5 Bird Banding by Systematic Trapping By S Prentiss Baldwin Pp 125 168+plates 19 25 (Cleveland Ohio)

Collection des travaux chimiques de Tchécoslovaquie Redigée et publiée par E Votoček et J Heyrovský Année 3 No 4 Avril Pp 187 240 (Prague Regia Societas Scientiarum Bohemica)

Publications of the United States Naval Observatory Second Series, Vol 13, Appendix 1 The Gravity Measuring Cruise of the U S Submarine S 21 By F A Vening Meinesz and F E Wright with an Appendix on Computational Procedure by Miss Eleanor A Lamson Pp x+94+9 plates (Washington D C Government Printing Office)

Det Kgl Danske Videnskabernes Selskabs Skrifter Naturvidenskabelig og mathematisk Afdeling 9 Række, IV 1 Contributions to the Study of the Development and Larval Forms of Echinoderms I II By Th Mortensen Pp 39+7 plates (København Andr Fred Høst and Søn)

Jahresbericht der Hamburger Sternwarte in Bergedorf fur das Jahr 1930 Erstattet von dem Direktor Dr R Schorr Pp 28+4 Tafeln (Bergedorf)

Mitteilungen der Hamburger Sternwarte in Bergedorf Band 6 Nr 34 Sechster Nachtrag zum Eigenbewegungs Lexikon Zusammengestellt von W Kruse und B Imgart Pp 221 327 (Bergedorf)

Det Kgl Danske Videnskabernes Selskab Biologiske Meddelelser, Bind 10, Nr 1 Der grosse europaisch sibirische Kreuzschnabelzug 1927 Von Ad S Jensen Pp 27 (København Andr Fred Høst and Søn) 1 00 kr

Ministerio da Educacao e Saude Publica. Annuario publicado pelo Observatorio Nacional do Rio de Janeiro para o Anno de 1931 Anno 47 Pp xv+426 (Rio de Janeiro)

Japanese Journal of Geology and Geography Transactions and Abstracts, Vol 8, No 3. Pp iii+113 289+13 27 Japanese Journal of Mathematics Transactions and Abstracts Vol 7 No 4 March Pp 267 346+22 Japanese Journal of Botany Transactions and Abstracts, Vol 5 No 3, March Pp v+253 369+55 87 (Tokyo National Research Council of Japan)

Egyptian University Faculty of Medicine. A Study of Hairs and Wools belonging to the Mammalian Group of Animals, including a Special Study of Human Hair, considered from the Medico-Legal Aspect By Prof John Glaister Jun (Publication No. 2) Pp ii+188+145 plates. (Cairo Misr Press)

Soil Bulletin No 1, December Pp iii+38 No 2, March Pp ii+60+9 plates (Peiping Geological Survey of China.)

Annales de Zô se Tome 17 Fasc 4 Pp C31 (Zi ka wei)

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 6, No 4, April R P Nos 292 302 Pp 528 768 (Washington D C Government Printing Office)

Bulletin of the National Research Council No 82 List of Seismo logical Stations of the World Second edition Compiled by H E McComb and Clarence J West Pp ii+119 (Washington, D C National Academy of Sciences) 1 50 dollars

Diary of Societies

FRIDAY, JUNE 5

ROYAL SOCIETY OF MEDICINE (Laryngology Section) at 9 30 A M —Dr A B Kelly and Prof L Findlay Congenital Shortening of the Œsophagus, and the Thoracic Stomach resulting therefrom —Dr H G Hodgson The Radiography of Sinusitis —Prof G Portmann Treatment of Cicatricial Stenosis of the Œsophagus by Autodilatation —Sir StClair Thomson A Permanent Tracheostomy in Stenosis of the Larynx.—At 5 —O O Popper Demonstration of Broncho œsophagoscope

ROYAL SOCIETY OF ARTS (Indian Section) at 4 30 —Mrs Patrick Villiers Stuart The Indian Paradise Garden (Sir George Birdwood Memorial Lecture)

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5 —Dr H C Hepburn Electro osmosis and Electrolytic Water transport Part 2 —J S Badami Spectra of Trebly and Quadruply Ionised Antimony Sb IV and Sb V —G I Finch, R W Sutton and A E Tooke *A Time Base for the Cathode ray Oscillography of Irregularly* Recurring Phenomena —Dr R L Smith Rose and J S McPetrie The Attenuation of Ultra short Radio Waves due to the Resistance of the Earth —Prof S Chapman The Absorption and Dissociative Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth Part 2. Grazing Incidence —A Ripple tank Demon stration of Beats as Moving Interference Fringes, by M O Clarke

GEOLOGISTS ASSOCIATION (in Architectural Theatre, University College), at 7 30 —R O Jones The Development of the Tawe Drainage —Dr S W Wooldridge and C J C Ewing Further Observations on the Geology of the Lane End Eocene Outlier

WEST LONDON MEDICO CHIRURGICAL SOCIETY (at Kensington Town Hall), at 8 15 —Prof J S Huxley Development in Relation to Heredity and Evolution (Cavendish Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof E W MacBride Habit—the Driving Force in Evolution

TUESDAY, JUNE 9

MINERALOGICAL SOCIETY, at 5 30 —G E L Carter On an Occurrence of Vanadiferous Nodules on the Coast of South Devon —M H Hey Studies on the Zeolites Part II Thomsonite (including Faroelite) and Gonnardite —A Russell An Account of British Mineral Collectors and Dealers in the 17th 18th, and 19th Centuries (con tinued).—Dr L J Spencer (*a*) Hoba (South West Africa), the Largest Known Meteorite, (*b*) Twelfth List of New Mineral Names —Dr J L E Drugman On Different Habits of Fluorite Crystals

ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —Prof T Thomson Flynn Exhibition of Photographs of Living Tasmanian Marsupials.—Prof J Huxley The Relative Size of Antlers in Deer —T L Green The Anatomy and Histology of the Alimentary Canal in the Common Wasp *Vespa vulgaris* —Dr Marion A Hamilton The Morphology and Biology of *Nepa cinerea* Linn —S Maulik On the Structure of the Larvæ of Hispine Beetles —Prof F H Edgeworth (*a*) On the Muscles used in Shutting and Opening the Mouth, (*b*) On the Develop ment of the External Ocular, Masticatory, and Hyoid Muscles of the Monotremata (*c*) On the Development of the External Ocular, Masti catory, and Hyoid Muscles of *Sphenodon punctatus* —Joyce Omer Cooper Report on the Dytiscidæ (Coleoptera), Mr Omer Cooper s In vestigation of Abyssinian Fresh waters (Dr Hugh Scott s Expedition).

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30 —Prof H S Holden Wound healing in Plants.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 8 30 —Prof A Calmette B C G Immunisation of Infants

WEDNESDAY, JUNE 10

RESEARCH DEFENCE SOCIETY (Annual General Meeting) (at 11 Chandos Street, W 1), at 3 30 —Dr H H Dale The Effect of Research on Curative Medicine (Stephen Paget Memorial Lecture).

FARADAY SOCIETY (at Chemical Society), at 8.—*Annual General Meeting* —At 8 15 —Dr W H J Vernon (*a*) A Laboratory Study of the Atmospheric Corrosion of Metals Part 1 The Corrosion of Copper in Certain Synthetic Atmospheres, with particular reference to the Influence of Sulphur Dioxide in Air of Various Relative Humidities, (*b*) An Air Thermostat for Quantitative Laboratory Work —Dr W H J Vernon and L Whitby The Quantitative Humidification of Air in Laboratory Experiments

INSTITUTION OF STRUCTURAL ENGINEERS (at 10 Upper Belgrave Street), at 8 —H A Holt The Art of Making and Using Concrete (2) The Raw Materials of Concrete and their Field Testing

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8 15 —W T Griffiths Continental and American Practice in Nickel Deposition

ROYAL SOCIETY OF MEDICINE (Surgery Section) (Annual Meeting) (at Manchester Royal Infirmary).

THURSDAY, JUNE 11

ROYAL SOCIETY, at 4 30 —M L E Oliphant Electron Emission from Langmuir Probes and from the Cathode of the Glow Discharge through Gases —H E Watson, G Gundu Rao and K L Ramaswamy The Dielectric Coefficients of Gases Part I —G D Bengough, A. R. Lee and F Wormell The Theory of Metallic Corrosion IV

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 8 —Sir John H Parsons Young s Theory of Colour Vision (Thomas Young Oration).

FRIDAY, JUNE 12

ROYAL ASTRONOMICAL SOCIETY, at 5 —Dr L J Comrie Note on Mr Chappell s Method of Second Difference Integration —Bertha Swirles The Absorption Coefficient of a Degenerate Gas —G Castelnuovo De Sitter s Universe and the Motion of Nebulæ

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 5 —Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Dr C L Woolley Latest Excavations at Ur

PUBLIC LECTURES.

FRIDAY, JUNE 5

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —R R Hyde Industrial Welfare.

TUESDAY, JUNE 9

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division) at 5 —Sir George Buchanan International Hygiene

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary s Hospital W 2), at 5 —Prof J S Haldane The Problems of Silicosis

WEDNESDAY, JUNE 10

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —A T Pike Town Planning.

FRIDAY, JUNE 12

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5 —Sir Thomas Legge Industrial Poisonings

CONFERENCES.

JUNE 9 TO 12

INSTITUTE OF BRITISH FOUNDRYMEN (at Birmingham).

Wednesday June 10 (*morning*) (at Grand Hotel).—A Harley Presidential Address.

C W Spring The Effect of Elevated Temperatures on Grey Iron Castings

Prof H Thyssen Factors in the Conductivity of Irons

M Arzens The Laboratory and the Foundry

E N Simons The Merchandising of Castings

Dr J G A Skerl Sands and Sand Testing

J Arnott Silicon as an Alloying Element

W C Devereux High Duty Light Alloys

Thursday June 11 (at Coventry).—L H Pomeroy The Relationship between the Engineering and the Foundry Trades

J G Pearce Recent Developments in Cast Iron in Great Britain.

JUNE 10 TO 13

SOUTH EASTERN UNION OF SCIENTIFIC SOCIETIES (at Winchester).

Wednesday, June 10 at 8.—Sir J Arthur Thomson Some Natural History Problems of the Countryside (Presidential Address).

Thursday, June 11 (Botanical Section), at 11 A M —J Groves Stone worts, Ancient and Modern

At 11 45 A M —Prof S Mangham Plants as Civil Engineers.

(Archæological Section), at 11 A M —Dr W E St L Finny The Kings of Wessex from Egbert to Athelstan

At 12 45 —The late A Hadrian Allcroft The Pre History of the Village Church Part 2

Friday, June 12 (Geological Section), at 10 30 A.M —Prof H L Hawkins Some Generalisations on the Nature, Deposition, and Palæonto-logical Implications of the Chalk

At 11 45 A M.—F H Edmunds The Relation of Soil and Geology of the Weald

(Zoological Section), at 10 30 A M —J F Marshall The Stereoscopic Photomicrographs of Fossil Insects exhibited in the Congress Museum

At 11 A M —H. Main Insect Observations Underground

At 12 —E A Martin The Making of Pearls.

At 8 P M —W P D Stebbing A Motor Tour of 7500 miles from the Transvaal to Western Uganda (Public Lecture).

Saturday June 13 (Regional Survey Section), at 11 A M —H J E Peake Archæological Surveys.

SUMMER MEETING.

JUNE 11 TO 13.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Sheffield).

SATURDAY, JUNE 13, 1931.

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Education for the Engineering Industry.*

THE triumphs of engineering science and technique are reflected by every development of modern civilisation, and further development will depend, to a large extent, upon the continued supply of qualified and capable engineers Here, then, is constituted a need which must be provided by engineers and educationists of to-day It depends on them whether the engineers of the next generation shall be trained and educated in a manner suited to the importance of their calling

The import of this has been realised in some quarters for a considerable time In 1928 the Engineering and Education Sections of the British Association held a joint discussion upon "School, University, and Practical Training in the Education of the Engineer" Later in the same year, the President of the Board of Education appointed a Committee to inquire into technical education for the engineering industry The detailed and thorough nature of this investigation is shown by the Committee's report, which has been recently published by H M Stationery Office under the title "Education for the Engineering Industry"

In effect, this report is the expression of a general consensus of industrial opinion, and as such deserves careful consideration The tendency to direct attention to the practical or works executive side, almost to the exclusion of the office or administrative side, should be noticed Also, in accordance with the Committee's terms of reference, the report is, in the main, a review, interspersed with many valuable suggestions, but with no definite schemes for the amelioration of the evils noted To those interested in the subject, this last fact must cause real disappointment, for one cannot but feel that, if the duty had fallen within the scope of such a strong committee, some decisive and practicable schemes would have resulted Such recommendations would have received widespread and most careful attention

Considerable emphasis is brought to bear upon the subject of recruitment, and it might be well to review the sources of supply as reported About ninety per cent of the recruits come to the industry straight from the elementary school at the age of fourteen years, of the remainder, the majority probably come from junior technical schools at ages ranging from fifteen to sixteen years, while a smaller

* Education for the Engineering Industry 1 Report of the Committee on Education for the Engineering Industry, 2 Comments on the Report by Education Bodies Pp vii+67 (London H M Stationery Office, 1931) 1s 3d net.

proportion are recruited from secondary schools at ages from sixteen to seventeen years This neglects the comparatively small number received from universities and technical colleges

From the report, it would appear that, in general, recruitment is still carried out in a fashion quite haphazard, with little or no discrimination between the various types cited This alone renders the problem of subsequent training most difficult for all but very large industrial concerns, since no clearly defined regulations exist to guide individual firms Surely, as was suggested at the British Association in 1928, a standard national scheme of apprenticeship could be set up—a scheme which would be readily adaptable to suit the distinguishing features of at least the three main grades of recruits This is vitally an industrial concern, and that such an obvious opportunity should have passed unheeded forms a fit subject for regret

Industrial opinions on the merits of the three types of recruit are interesting The elementary school type is labelled satisfactory, with the caution that intelligent selection, preferably from central schools, is advisable, the junior technical school type would appear to have found unqualified approval, and recruitment from secondary schools is considered intrinsically sound Regarded as types, the first evidently finds least favour, but as the other two sources of supply cannot hope to cope with the demand, the problem of improving the general personnel of the engineering industry must centre in the betterment of the elementary school type This is in itself a task At the outset it must be realised that the majority of this section are not likely to profit by any serious degree of technical education Their subsequent learning, then, must consist almost entirely of purely descriptive work, with the aim of improving their ideas of the industry in particular and their outlook upon life in general The progress made during this course of descriptive work would readily indicate the minority capable of further advancement These remarks may, to a large extent, apply also to the junior technical school type of recruit The explanation of the favour bestowed upon this class may well lie in the fact that, in effect, these boys are highly selected the slight vocational bias in their training, even if it has no lasting effect, will certainly facilitate proper selection

The secondary school boy falls into quite a different category He is usually the pick of the elementary school type, advanced by a few years of higher education, and generally capable of assimilating a fair degree of technical instruction Unfortunately, in the report, he is all but maligned for showing a distinct preference for so-called 'black-coated' positions Assuming this to mean a preference for the office and, ultimately, the administrative side, is it not a quite natural tendency? Surely a certain incompatibility exists between higher education and manual labour A good grounding on the practical side is undoubtedly necessary for those aspiring to administrative posts, and apprentices with this aim in view will not object to gain their experience in the workshops On the other hand, perhaps the most progressive suggestion of all in this report concerns this class of recruit It is proposed that the period spent at school between the normal age of entry to apprenticeship and actual entry should be treated as part of the apprenticeship period It is also of interest to note that vocational training in secondary schools is not advocated, this conforms to general academic opinion

Regret is expressed at the divorce of men with high technical qualifications from the practical side of the engineering industry Such a situation is, however, not surprising if the note appended to the report by one of the members of the Committee is a true indication of the feelings of employers He states that he does not think that the average employer in general engineering works of Great Britain would be likely to train university students and afterwards offer them positions in productive departments No reasons are given Is this further evidence of the persistence of that old reluctance of the industrialists to admit the need for technical training? It is surely fundamentally right that the higher posts in industry should be filled by well-trained men How one can hope to become highly trained in these days without attending the university or technical college is difficult to understand

Finally, the admirable part of the report is that in which concerted action between industry and college, extension of part-time education, active encouragement for the boy with ability, and rational methods of promotion are all enthusiastically recommended Here we have evidence that these subjects are at last receiving sincere attention It is, however, unfortunate that no schemes are drawn up to show how these desirable objectives may be reached It can only be hoped that these recommendations will receive the immediate attention of all to whom they are directed Here the valuable suggestions appended to the report by Mr A E Berriman might well serve as guidance for a definite line of attack

Mathematics and the French Mind

(1) *Cours de mécanique mécanique des solides indéformables, mécanique des milieux continus déformables, théorie sommaire des machines et de l'aviation, les mécaniques de Newton et d'Einstein* Par Prof Paul Painlevé et Prof Charles Platrier (Cours de l'École polytechnique) Pp viii + 644 (Paris Gauthier-Villars et Cie, 1929) 150 francs

(2) *Cours de géométrie* Par M d'Ocagne Première partie *Géométrie pure*. Deuxième partie *Géométrie appliquée* Pp xi + 429 (Paris Gauthier Villars et Cie, 1930) 120 francs

(3) *Cours d'analyse professé à l'École polytechnique* Par Prof J Hadamard Tome 2 *Potentiel, calcul des variations, fonctions analytiques, équations différentielles et aux dérivées partielles, calcul des probabilités* Pp vi + 721 (Paris Hermann et Cie, 1930) 140 francs

(4) *Cours de mathématiques générales* (*analyse et géométrie*) Par René Garnier (Cours de la Faculte des Sciences de Paris) Tome 1 *Calcul différentiel, géométrie* Pp xi + 463 (Paris Gauthier Villars et Cie, 1930) 80 francs

(5) *Erreurs et moindres carrés* Par Prof R Deltheil (*Traité du calcul des probabilités et de ses applications*, par Émile Borel Tome 1 *Les principes de la théorie des probabilités*, fascicule 2) Pp vi + 161 (Paris Gauthier Villars et Cie, 1930) 30 francs

(6) *Principes géométriques d'analyse* Par Prof Gaston Julia Première partie *Leçons faites a la Sorbonne* Recueillies et redigées par Marcel Brelot et René de Possel (Cahiers scientifiques, Fascicule 6) Pp vi + 116 (Paris Gauthier-Villars et Cie, 1930) 25 francs

(7) *Leçons sur les ensembles analytiques et leurs applications* Par Prof Nicolas Lusin (Collection de Monographies sur la Théorie des Fonctions) Pp xv + 328 (Paris Gauthier-Villars et Cie, 1930) 60 francs

MANY consider mathematics to be the most abstract and inhuman of the sciences, but to the connoisseur a mathematical treatise is a work of art, revealing by its style the temperament, aspirations, and even the human weaknesses of its author When we consider a collection of French books on pure and applied mathematics, we are reminded of the great differences between French and English ideals The clarity of the French style is well known and "what is not clear is not French" It was also a Frenchman who said that "language was given to us in order that we might conceal our thoughts", but this maxim appears to have influenced German and, to a lesser degree, English writers more than his own countrymen

Closely allied to clarity is the importance attached to logical precision In the training of French engineers at l'École polytechnique, for example, the course in elasticity will be a closely reasoned mathematical investigation, in which a logical flaw would be regarded as a scandal When their studies are complete, the young engineers will go out into the world and discover with amazement that the problems of actual machines are not always amenable to such refined methods In some cases they will adapt themselves to practical requirements, but in others they may feel a lasting prejudice against practical work and never really settle down to the real requirements of their profession In England, on the other hand, the tendency is to emphasise the practical aspect at the expense of the underlying theory This has the disadvantage that persons so trained may not have sufficient grasp of fundamental principles, in spite of their knowledge of current routine, to be able to cope with new conditions that may arise In both nations the really capable men will ultimately become masters of their subject, but the Frenchmen will tend to approach the particular through the general the concrete through the abstract, while the Englishmen tend to reverse the process

French mathematical books give a lucid account of general theories, but too often leave them in the air, without investigating their detailed application French mathematical students, if we may judge from their text books, work very few examples M le Chatelier has deplored the fact that too many students confine themselves to learning their lecture notes by heart He considers that they should work out examples for themselves, but regrets that this ideal seems impossible of attainment In England, on the other hand, the working of problems is firmly established as the essential feature of mathematical study Unfortunately, this feature, so good in moderation, is apt to be carried to extremes, as in the old Mathematical Tripos, which was considered to be largely responsible for the sterility of many who should have contributed to the advancement of their subject

In France there is no lack of research in pure mathematics, and here the instinct of generalisation finds a legitimate and fruitful opportunity Until the present century, British mathematicians have done best in applied mathematics, where the somewhat incoherent and not fully logical work of men like Maxwell has proved to be of more permanent value than the more closely knit and elaborate

efforts of French writers which have now fallen into the background However, in recent years a change has taken place At least two English pure mathematicians have a world wide reputation, while the new syllabus for French schools and colleges is much less abstract than the old Perhaps at last the two nations are learning from each other

We shall now deal briefly with the special features of the books under review

(1) Profs Painlevé and Platrier cover a much wider range than any English course of mechanics, for in addition to the usual rigid dynamics, hydrostatics, and hydrodynamics, there is a thorough treatment of elasticity, a little about steam engines, gas engines, and turbines, three short chapters on aviation, and finally both the special and general theory of relativity Until 1929 the course was lithographed, but the excess of material caused this arrangement to break down It is to be hoped that the effect upon the students will not be similar But if it is really necessary that they should have to be taught such an enormous range of subjects, they certainly have it presented to them in the best possible manner The section on gyroscopic motion is particularly notable

(2) and (3) The second and third books on the list are, like (1), part of the course at l'École Polytechnique, the students of which, it must be remembered, are selected by severe competitive examination (2) M d'Ocagne begins with homographic and other transformations, and then goes on to the differential geometry of plane and skew curves and of surfaces, and to line geometry The later parts of the book deal with applied geometry, including mechanism, graphical statics, graphical integration, and finally nomography (3) Prof Hadamard includes potential, calculus of variations, analytic functions, elliptic functions, differential equations (ordinary and partial), and probability The book differs from the well known courses of analysis by Goursat or Picard in that it contains many references to problems in mathematical physics, which add considerably to its interest It is pleasing to notice that the French, sometimes said to be the most insular of nations, have discovered the merits of the numerical method of solving differential equations given by the Englishman, John Couch Adams, the account given here is taken from a Russian contribution, written in French, to a French journal

(4) M Garnier has written out the elementary course in analysis and geometry, taken in the first six months at the University of Paris, by those who are preparing for a study of the physical sciences The first part deals with calculus, infinite series, and complex numbers, and authors of English elementary works could consult it with advantage for elegant methods of treating bookwork The second part has a very brief treatment (43 pages) of curves and surfaces of the second degree (quite inadequate from an English point of view), and then more than a hundred pages of differential geometry

(5) Prof Deltheil has prepared a part for the extensive treatise on probability edited by Borel It deals with the theory of errors and least squares on classical lines It is, from its own point of view, quite good, but we regret that the opening chapter is devoted to inverse probability without any mention of the condemnation of this theory by Dr R A Fisher, whose work on small samples, treated by the 'method of likelihood', seems of fundamental importance

(6) Prof Julia's book is an attempt to link up geometry and the theory of functions A study is made of certain transformations, in particular of a circle into itself These lead to some of the fundamental inequalities of analysis A sequel to this volume will deal with the researches of Lindelöf and Littlewood

(7) The last book on our list is by a Russian, but it owes a good deal to French influence, and the author's originality in arriving at mathematical results by way of philosophy is eulogised in a preface by Lebesgue It deals with the difficult questions of the theory of aggregates, which are on the border line between mathematics and philosophy In this subject it seems difficult to arrive at the truth, and the author considers that some work hitherto generally accepted is fallacious "Philosophers", said Einstein, "are children who play with words", and M Lusin concludes by warning us that philosophic considerations are always vague, and that we must rely on what may be called observed mathematical facts

H T H PIAGGIO

The Great Zimbabwe Problem

The Zimbabwe Culture Ruins and Reactions By G Caton-Thompson Pp xxiv + 299 + 74 plates (Oxford Clarendon Press, London Oxford University Press, 1931) 25*s* net

IT is believed that Miss Caton-Thompson's admirable survey of this problem will finally lay to rest a controversy which has now continued for more than thirty years, in fact, it may be flippantly described as 'the great Zimbabwe myth', and few

in England will credit the heat which this discussion engendered An idea sprang up, soon after the discovery of the ruins by the Rhodesian pioneers, that they were of immense age, and the opinion grew that Rhodesia was the great source of the alleged wealth of the Sabæans, the ruins being the remains of a fortress designed to protect the gold trade, others, for some reason, claimed that they were built by Phœnician traders These theories were encouraged by Bent, who explored the ruins about 1891, and to some extent by Hall and Neal, who did further work there about 1901 The pronouncements of these investigators appealed to a public in South Africa who revelled in the romantic atmosphere, which was fully exploited by journalistic pens In fact, the fervour evoked was so great that anyone who was bold enough to express doubt was looked upon as a terrible iconoclast, if not worse

Randall MacIver in 1905 carried out some careful excavation work at Zimbabwe and other places, and he was the first person to place the solution of the problem on a scientific stratigraphical basis As is well known, he reported that nothing could be found which could be dated as being earlier than medieval times, and as regards the architecture, it exhibited no trace of Oriental or European origin

These conclusions produced an angry storm of criticism and did little to dissipate the cloud of misconception A local worker in Rhodesia, Mr J F Schofield, however, reopened the discussion in 1925 and produced some pertinent evidence Most professional archæologists were all along satisfied of the soundness of MacIver's conclusions, but the technique of archæological research has progressed in the last twenty five years and therefore the British Association decided that, as it was visiting South Africa in 1929, it would be a fitting occasion for an effort to settle a number of points which it was felt had been incompletely dealt with by the MacIver Expedition Miss Caton Thompson was entrusted with the mission and, accompanied by Miss Norie and Miss Kenyon, spent some five months on her task

The results are set forth in the volume now before us, and they provide an example of the best systematic archæological work of to day, and it is believed that the logic of the deductions cannot fail to disperse the misconceptions which have for so long persisted It is difficult to understand that any modification of current ideas regarding the origin of the ruins should be considered to damage their interest, a little reflection will show that this is not the case, and it is to be hoped that Miss Caton-Thompson's investigations will prove a basis for, and also a stimulus to, further archæological research in South Africa and Rhodesia, for they afford a pattern as regards method and the various unanswered questions are clearly specified

Miss Caton Thompson, upon arrival at the site, was faced with the problem which all archæologists have to decide, namely, "Where shall I, in the time at my disposal, with the means at my command, be likely to obtain definite results?" The main enclosure at Zimbabwe had been dug over in every direction for years past by prospectors and archæologists, thus being ruined by disturbance She therefore decided to explore fully, in the first place, the Maund ruins near by, for there is reason to believe that they are coeval with the main buildings, and, further, the cement floor which is such a persistent feature in these ruins was more or less intact This floor, of course, seals off everything prior to its formation and it therefore is of definite stratigraphic value, as constituting a datum level, and in a research, the particular object of which was to discover datable articles in undisturbed layers of deposits, it is thus of great importance providing the evidence is carefully interpreted

Two distinct periods of occupation were proved, one marked by the stone walls and the cement floors and a later one characterised by mud mounds, the degraded relics of buildings, the work of successors to these sites It is of great importance to note that practically everything found was, beyond doubt, of African origin As on previous occasions a few exotic sherds of pottery and some foreign beads were found In some cases the beads were in association with skeletal remains of Africans These objects were evidently traded from either Sofala or Tete, and the wonder is that there are not more

The next site to be examined was the elliptical structure containing the conical tower which is the best known feature of these ruins As the author states "Around the famous tower have rallied all the theories of the exotic origin of the Rhodesian ruins and it was fitting therefore that it should submit to a final test"

With the permission of the Rhodesian Government, a tunnel was driven under the tower and a small collection of objects was obtained therefrom, but nothing to which any great age can be attributed and nothing of foreign origin After this a considerable amount of work was done at the so-called "Acropolis", and to avoid confusion due to previous excavation and refilling on the top of the hill, attention was wisely confined to dissection of the old rubbish-heaps which here and there are to

be found on the flanks Here again practically every object was of African origin

Miss Caton Thompson cast her net widely, however, and ignored no site which might be productive of useful evidence She therefore explored a number of ruins to the north east of Zimbabwe—Chiwona, Matendere, Mshosho, and Hubvumi, also Dhlo-Dhlo, some fifty miles to the west In none of these did she discover anything to conflict with the sequence found at and near Zimbabwe

Now with regard to general conclusions, MacIver's dictum that the ruins were medieval and post-medieval appears to be generally correct But Miss Caton Thompson concedes that the commencement date of the buildings may go back as far as the ninth century A D, this conclusion being based on the age determination of imported beads found here and there, but the earliest date from other evidence seems to be not earlier than the thirteenth century, and, curiously enough, the soapstone objects, upon the exotic origin of which so much argument has been based, appear, so far as can be determined, to come rather late in the sequence

It is, however, impossible and even inadvisable in the limits of a review to attempt to give a complete résumé of the methodical steps by which all these conclusions have been reached One thing becomes clear that it is mainly by the aid of meticulous research of this character that concrete evidence will be obtained regarding the various waves of people which have swept into South Africa from the north during the last two thousand years, and which are loosely termed the Bantu invasions

The work is well produced and profusely illustrated C W H

Flora of Central Asia

(1) *The Plant Introductions of Reginald Farrer* Edited by E H M Cox Pp xi + 113 + 12 plates (London New Flora and Silva, Ltd, 1930) 50s

(2) *Plant Hunting on the Edge of the World* By F Kingdon Ward Pp 383 + 16 plates (London Victor Gollancz, Ltd, 1930) 21s net

(3) *Wild Flowers of Kashmir* (Series 3) By B O Coventry Pp xix + 100 + xxi-xxix + 51 plates (London and Leicester Raithby, Lawrence and Co, Ltd, 1930) 16s

(1) TO those who knew Farrer personally and to the many who have enjoyed his writings, this book will make instant appeal Farrer left his mark on English horticulture, and it is only fitting that there should be an account of his work and especially of his venturesome last years in western China and Burma The main part of the book is devoted to an annotated list of the plants secured in Farrer's journeys in Kansu in 1914–15 and to his explorations on the Burmese frontier in 1919–20 The introduction is adequate and eminently readable The writer of the book has had no light task, for the written records of these expeditions are imperfect, Farrer's plants and seeds from Kansu received but scant attention during the War, and his untimely death on the Burmese frontier left his last notes and collections in some confusion Fortunately, Mr E H M Cox had the opportunity of accompanying Farrer for part of his Burmese expedition and can therefore write with first-hand knowledge He has supplemented this by visits to most of the gardens where Farrer's plants are likely to be found His has been a careful analysis The results are satisfactory, and Farrer has been fortunate in his biographer

The book is well printed on excellent paper The illustrations are attractive, and among them are twelve coloured reproductions of paintings by Farrer in the field These illustrations, representing plants of the Burmese frontier, are of high merit and add much to the value of the book A few errors in the botanical names and terms have survived the proof-reading, but these are few

Apart from those who will read the book from interest in Farrer, the record of plants found by him in Kansu and Burma, with his annotations and descriptions, is such as must be recognised by botanical institutions and by those horticulturists (and they are many) who are keen on the floral treasures of these regions

(2) Those acquainted with Mr. Kingdon Ward's previous books of venturesome travel in central Asia, such as "The Land of the Blue Poppy", will welcome this noteworthy record of botanical exploration in one of the least-known corners of the world The first half gives an account of the author's journey in 1926 through that part of extreme north-west Burma bordering on Tibet and China, and the rest of the book is devoted to a subsequent journey in 1928 through the hinterland of the Assam Himalaya, again leading to Tibet and China It is an uninviting region to the traveller —with uncouth and unfriendly natives, dense jungles, and heavy rainfall To travellers of Mr Kingdon Ward's type it is redeemed by the interest of its flora, especially as regards its alpine plants

Little is known of the fauna and flora of this

region—a vast tangle of mountains between the Himalaya and the Chinese Alps The author has, in these and previous expeditions, made valuable contributions, both biological and geographical Many of the plants referred to in the text bear unfamiliar names, but that is simply because the plants were unknown previously and have but recently been described Even for the non-botanical reader the book well repays perusal It is written in an easy style and well illustrated

(3) Mr Coventry's book on the wild flowers of Kashmir is the third of the series, and is on the same lines as the previous two Fifty additional Kashmir plants are annotated and figured Every visitor to the delectable land of Kashmir who is interested in its flora, should take these three handy volumes as his companions The only alternatives are the bulky seven tomes of the "Flora of British India" and certain published lists of the plants of the north-west Himalaya These lack illustrations and otherwise do not appeal to the traveller who is not a professed botanist The figures in the series under review are coloured and are reproduced from the direct colour photographs of the author They are of very high merit, not only in the reproduction, but also in the choice of the material The botanist may miss the dissections which are the normal accompaniment of botanical illustrations, but the author has caught the *facies* of each plant so well that they need not be regretted With the adequate and clearly expressed text, the results are very satisfactory, and lovers of Kashmir will welcome additions to the series

Our Bookshelf.

The Animal Mind By C Lloyd Morgan Pp xii + 275 (London Edward Arnold and Co, 1930) 12*s* 6*d* net

IN the preface to "The Animal Mind", Prof Lloyd Morgan quotes the words of Don Quixote to the Duchess "God only knows whether there be any Dulcinea or not in the world " Let us be quixotic enough, adds the author, "and some behaviourists say that it is sheer quixotry—to believe that our Dulcinea does exist " This sentence sums up the difficulties of a biologist who is asked to review "The Animal Mind", if he does not agree with the *Weltanschauung* of the author Either you agree with Prof Lloyd Morgan's views about scientific method and regard the views he expresses about animals as a contribution to scientific knowledge, or you do not agree with Prof Lloyd Morgan's views about scientific method and are therefore compelled to say courteously but unequivocally that science is not advanced by speculations about what goes on in the mind as opposed to the central nervous system of an animal, and that the attempt to "put yourself in his place" is the very antithesis of the procedure which the scientific worker adopts in studying the characteristics of living matter

The method of extensive introspection or, as the author himself calls it, "putting yourself in its place", is set forth in the following passage, which refers to the author's observations on his dog Tony "Let me try to illustrate what I mean from what I may call the ball-situation and the stream situation, putting myself in Tony's place I, Tony, have learned to swim across a still pond and fetch things out of it Meanwhile I have been learning quite a lot in ball situations Among other things I have learned this that if I follow a swift running ball up to a wall, and from the wall as it rebounds at an angle " Those to whom this method of investigation appeals may refer to the text for the remainder of a soliloquy in which Prof Lloyd Morgan, alias Tony, tortures his motives like the heroine of a Russian novel

To those who place confidence in the method of Sherrington and Pavlov, the relevant issue is not whether Dulcinea exists, but whether Dulcinea belongs to fiction or to science They will not wish to rob Prof Lloyd Morgan of what comfort his Dulcinea can give him They will merely insist that her place is the library In the laboratory her charms will distract them from the serious business of the scientific worker

Untersuchungen an Luftwurzeln Von K Goebel und W Sandt (Botanische Abhandlungen, herausgegeben von Prof K Goebel, Heft 17) Pp 124 + 6 Tafeln (Jena Gustav Fischer, 1930) 12 gold marks

THE senior author of the monograph, Prof Karl von Goebel, during his journeys in the tropics made numerous observations upon the aerial roots of epiphytes, interesting and characteristic features of tropical vegetation, but he was not able to give them the systematic attention he desired Dr W Sandt has therefore continued to study them, under Prof von Goebel's direction, using the very fine collection of epiphytes growing in the glasshouses in the Munich Botanic Gardens, where anatomical and physiological studies were also possible The main point under examination was the growth habit of these roots before and after entering the soil Dr Sandt confirms the earlier observations of Sachs and others, that in these aerial roots the growing region may be extraordinarily long and that this adequately accounts for the remarkable daily increment of growth of some of these aerial roots

These roots, which grow obliquely, not vertically, downwards, are usually quite unbranched unless the apex is damaged Branch root primordia may be formed, but do not grow out so long as this vigorous growth of the main root continues When the root enters the soil, however, the zone of growth very rapidly becomes of the normal, comparatively narrow dimensions, and then the branch roots may

grow out, the main root apex also grows very slowly or not at all in water, whilst branch roots develop freely Numerous measurements on the growth of marked roots and some observations and experiments upon absorption by them are described, and the regions of the roots, growing in air and soil, are briefly compared in their anatomy

Experimental Mechanical Engineering for Engineers and for Students in Engineering Laboratories By Prof Herman Diederichs and Prof William C Andrae Vol 1 *Engineering Instruments* Pp viii + 1082 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1930) 40*s* net

THE precise methods of the physical laboratory have long since been applied in the realm of engineering practice In workshops, factories, engine rooms, and steel works, scientific apparatus is found in ever increasing quantity Specifications are drawn up with scientific accuracy and contracts have to be carried out within fine limits Not only during tests, but also as a matter of daily routine, records of pressure, temperatures, velocities, volumes, and analyses have to be taken at frequent intervals, and every engineer must be something of a physicist Of the scientific apparatus in use, there is an endless variety constantly being added to, and the need of an authoritative text book on the subject is apparent

To meet this need, the authors of "Experimental Mechanical Engineering" have compiled this work on engineering instruments, their construction, use, and calibration Chapters deal in turn with the measurement of length, area, time, speed, pressure, temperature, work and power, liquids, gas, vapours, and fuel analysis, exhaust and flue gas analysis, and lubrication They are well illustrated by diagrams, and references are given to the sources of information This is a book which should be in the library of every technical college, every drawing office, and of every engineer who is concerned with the testing and running of plant A second volume is to be published to cover the testing of power plant apparatus as laid down in the codes of the American Society of Mechanical Engineers

Plants of the Gold Coast By Dr F R Irvine Pp lxxix + 52 + 32 plates (London Oxford University Press, 1930) 5*s* net

THE author of this work, who is master of agriculture and biology at Achimota College, is anxious to commit to print the vernacular names of plants of the Gold Coast and their relevant proverbs, with interpretations, before they are forgotten in the changed conditions of modern life The work has been undertaken mainly to help African teachers and other Africans who are willing to take an interest in their flora

The introduction contains much of interest, amongst which the author summarises his investigations into plant lore, herbalism, and the economic uses of local plants A list of economic plants shows the species grouped according to their value for oils, fibres, timber, drugs, etc The lists of native names are a valuable record They are written in the new and unfamiliar script recommended by Dr Westermann and the International Institute of African Languages and Cultures The greater part of the book consists of an enumeration of the plants, with brief descriptions and notes on plant lore, in English The arrangement is alphabetical, under the botanical names The author welcomes suggestions for a future edition The experience he will gain in the meantime will undoubtedly lead him to reconsider the scope of the work

There are some good representative photographs of the vegetation and a few line drawings The low price of 5*s* is due to the financial assistance given by the Gold Coast Government to enable the author to achieve his object and place his book before the Gold Coast people

A New Algebra for Schools By Clement V Durell Parts 1 and 2 Pp ix + 328 + xxiv + xxiii + xv (London G Bell and Sons, Ltd , 1930) Without Appendix with Answers, 3*s* 6*d* , without Answers, 3*s* With Appendix with Answers, 4*s* 6*d* , without Answers, 4*s*

THIS book has been written for the ordinary pupil, and an excellent course has been devised whereby the initial difficulties in algebra, due largely to the symbolic notation, may be overcome In the early stages, the student is trained to think in numbers when using letters Simple practical formulæ are then developed in such a way as to exhibit the utility of the notation The volume, embracing parts 1 and 2, each corresponding to a normal year's work, carries the subject up to quadratic equations, and a characteristic feature lies in the numerous illustrations drawn from geometry, physics, and mechanics At the present time, when progressive teachers are strongly advocating a greater degree of unification in school mathematical subjects, such a book as this is very welcome There is an abundance of exercises to meet the needs of both ordinary pupils and those of special ability

An Index to the Chemical Action of Micro organisms on the Non-Nitrogenous Organic Compounds By Prof Ellis I Fulmer and Prof C H Werkman, assisted by Anella Wieben and Calvin R Breden Pp xiii + 198 (London Baillière, Tindall and Cox, 1930) 20*s* net

THIS book is a useful aid to biochemists wishing to know where to obtain information about the chemical action of micro-organisms The contents are tabulated to show the action of each organism on all the substrates which have been examined and in each case the products found, the authority, and the reference to the literature Each item is cross referenced under "Substrate" and again under "Products" So far as the writer has been able to test it, the information is fairly complete The present instalment deals only with organic, non-nitrogenous substances, and it is to be hoped that a further section dealing with other substrates will soon appear

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Pliny's Water-Mill

A PHOTOGRAPH of a water mill which recently reached me from Kashgar in Turkestan is reproduced in Fig. 1. It has taken me two years to secure this photograph, and, so far as I can trace, no illustration of a mill of this peculiar type has hitherto appeared in any British or American publication, though references to such mills will be found in the works of a number of explorers in the Far East.

Copyright] [H. P. Vowles

FIG. 1

The interest of this particular mill lies in the fact that Pliny appears to have referred to water mills of a similar type in his "Natural History" (xviii. 23). It will be noted that the water wheel, which is undershot, does not drive mill stones through gearing, but operates pestles by a 'trip hammer' action. Pegs on the horizontal axle come in contact with the short ends of two pivoted levers as the axle rotates. The short ends are depressed alternately, the other ends of the levers—which carry pestles—then rising; further rotation of the axle releasing the levers so that the pestles fall by their own weight into mortars containing grain or rice.

After discussing hand operated pestles for crushing grain, Pliny remarks: "Maior pars Italiae ruido utitur pilo: rotis etiam quas aqua verset obiter, et molat." This has been variously translated, but I think the following gives the sense of the words correctly: "In the greater part of Italy is used a roughened pestle, with wheels which the water turns in passing, and so it grinds." The passage is admittedly obscure, but with the knowledge that the pestle and mortar water-mill actually exists, I think we may reasonably infer that Pliny refers to this type.

Further evidence, albeit indirect, is afforded by the fact that mechanism precisely similar in principle, though differing in application, is described and illustrated by Heron of Alexandria in his "Pneumatics". The difference lies in the fact that Heron substitutes a wind wheel for a water wheel, and a piston falling by its own weight in a cylinder for the pestle falling by its own weight into a mortar.

It is not improbable that this type of water mill was invented before the geared mill described by Vitruvius, and developed out of the (I think) still earlier water raising wheel used for irrigation purposes, a vague reference to which occurs so far back as Sumerian times ('Cambridge Ancient History", vol. 1, p. 461). There are two other types of water mill without gearing, but I have been unable to find any evidence for either in the literature of antiquity. Certainly no evidence is given by Bennett and Elton, in their "History of Cornmilling", in support of their view that the horizontal water wheel on a vertical spindle was known in Græco-Roman times, though one may reasonably suspect, from its primitive design and construction, that it was originally invented at an early stage of civilisation. I hope to give fuller details in a paper to be read before Section H of the British Association in September.

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Classification for Bibliography of Science—A Problem

THE relations of bibliography to science with especial regard to classification, as brought forward in Dr. S. C. Bradford's recent articles in NATURE,[1] have for many years been my purposive study. I welcome the renewed and increasing interest in the problems involved. It is very regrettable, however, that these matters were not considered more wisely a quarter of a century ago. What can best be done now should indeed become a question of major importance to scientific workers, to bibliographers, and to librarians.

Classification, affirmed to be fundamental to scientific method, has not yet been applied to scientific literature methodically and in a scientifically organised system. This should now become a first concern of the national and international organisations. The reasons for this, so well stated by Dr. Bradford, have been urged by me elsewhere on broad grounds.

The International Catalogue of Scientific Literature rejected in 1896 the classifications then proposed, and the study of the question was remitted to the Committee on organisation.[2] In the face of this negation on the part of the scientific workers, the International Institute of Bibliography soon after adopted an arbitrary classification devised by an American undergraduate in 1875 for the college library he was then serving. This was the famous Decimal Classification of Melvil Dewey. Its undeniable disqualification is that it is illogical and unscientific.

This system separates Science in Class 5 from Philosophy in Class 1 and places it subsequent to Social Science in Class 3, which is remote from History in Class 9. Then Philology in Class 4 it dissevers from Literature in Class 8, so all the literatures are severed from their languages. Biology and psychology, so far from being treated as distinct, fundamental sciences, are misrelated and dispersed. Biochemistry is given place neither under biology nor under chemistry, nor even in the index. These few examples of the disorder and inadequacy that pervade

the system justify my criticism [3] that it is disqualified and inadaptable for scientific development.

The doctrine that such disorder matters little, that specific subjects however misrelated can be brought together by the index and by cross references, I have termed the subject index illusion. Without subordination of the specific to the generic, division produces dispersion of subjects that an alphabetic index does *not* countervail.

The International Institute, conceding to the proprietor's conservative regard for American public libraries, has engaged to maintain the basic order of the thousand subjects unchanged except for a few alterations in headings; but has been free to elaborate specific subdivision and to develop a complementary mnemonic notation. This however is too lengthy and complicated for bibliographic uses: for example, experimental psychology of children is marked 612.821.3-031, where three letters would suffice, *I* for psychology, *IB* for physiological and experimental, and *IBF* for that of children. The complexity is exemplified by such combinations as 9(44) "17" = 2 for history of France in the eighteenth century written in English, which an economical notation would mark simply with four letters, *MSLF* for the periods of the history of France, *MS* for the eighteenth century, *L*, and for English *E*.

Dr. Bradford has applied to the Decimal Classification the term 'Universal'. It may be regarded as international in some respects, but indeed not universal; it is not even internationally dominant. In America since 1900 it has been adopted by very few scientific and university libraries, the classification of the Library of Congress having been preferred. But there are strong objections to this system too, not only on scientific grounds but also because of its cumbersome complexity. Moreover, such a classification is not available for standardisation because it is not typical.

In systems of selection, of cataloguing, and of classification, co-operation and economy depend on standardisation; but we should consider how and in what measure. Would it pay to standardise an arbitrary classification for scientific bibliography? Does co-operation require that? I think not; and I proffer a constructive solution to the problem. The whole ground is treated comprehensively in my book on "The Organization of Knowledge and the System of the Sciences", reviewed in NATURE of Aug. 9, 1930, p. 199. That book is fundamental to a second volume offering a comprehensive study of the problem of bibliographic classification, which will probably be published this year by the American Library Association. It advocates co-operative development and standardisation of a basic classification and notation consistent with accepted principles and with the organisation of science, and adaptable to national, special and typical conditions and requirements. A definite plan for co-operation in selection, cataloguing, and classification was outlined by me at the Conference of the American Library Association at Toronto in 1927.

International co-operation is of so great importance to us now that we should avoid detraction save for social economy. But the problem of bibliographic classification is as yet unsolved. It is involved in library economies; it is immersed in a historical situation. We cannot avail ourselves of standardisation while bibliographers advocate one system and librarians adopt another, though scientific workers find both very unsatisfactory. It behoves scientific workers, therefore, to examine this matter for themselves and to undertake to solve it in an internationally organised system.

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[1] Sept. 13, Oct. 4 and 11.
[2] NATURE, July 23, 1896, 54, p. 272.
[3] *Library Journal*, Dec. 1912.

Isotope Effect and Hyperfine Structure of the Mercury Resonance Line

RECENTLY Schuler and Keyston [1] have made some interesting studies on the hyperfine structure of the spectral lines of thallium, from which they conclude that the hyperfine structure is due in part to a relative shift of the spectral terms due to two isotopes of thallium (203 and 205), *originating from differences in the structure of the electric field of the atomic nucleus*. The isotope splitting is greatest in the terms with relatively small nuclear moment splittings.

In connexion with the investigations on hyperfine structure of the mercury resonance line 2537 A., I have been able to confirm by experiments the existence of the above mentioned effect. I investigated the hyperfine structure of the mercury resonance radiation excited with different combinations of the 2537 A. line components, the isolation of the components being realised in the way described in a former paper.[2] These experiments showed that every component gives a pure resonance effect: this proves that the normal $1\,{}^1S_0$ level of the mercury atom is single.[3]

Further, my studies on the influence of admixture of non-extinguishing foreign gases to the resonating vapour proved that the components of the 2537 A. line can be divided into two groups: (1) components

FIG. 1.

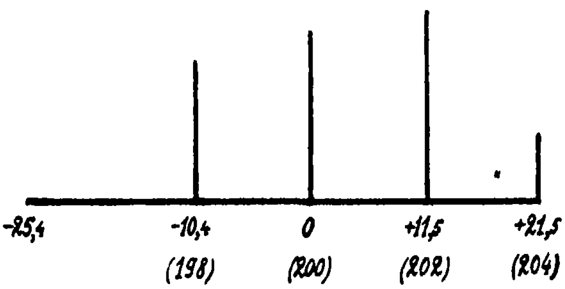

FIG. 2.

with an independent existence: even if considerable quantities of foreign gases are added (40 mm. nitrogen) they show the pure resonance effect—such are the components 0 and +11·5 mA.; (2) components which show a coupling such that they appear all together with the exciting line (−25·4 mA.) with greater additions of foreign gases—such are the lines −25·4, −10·4, and +21·5 mA. The lines of the first kind belong to different isotopes, those of the second to the same kind of atoms. The splitting of the latter is thus certainly due to the existence of the magnetic moment of the nucleus, which would in part confirm the hypothesis suggested by me elsewhere.[4]

The relations of intensities of the three lines of the second group in monochromatically excited resonance radiation with the −25·4 mA. component, in the presence of large quantities of foreign gas (represented qualitatively on Fig. 1), as well as my new investigations on the Zeeman effect in absorption in fields up to 15 kilogauss, show, however, that the structure of the 2537 A. line is certainly more complicated and arises from the incidental overlapping of the lines belonging to different isotopes. The relationships

to which the above mentioned investigations lead are represented on the Fig 2 (isotopes with zero nuclear moment) the lengths of the respective lines indicate their relative intensities These intensities, or the absorption coefficients, do not give us directly the proportion of the various kinds of isotopes, because the probability of the transitions may not be the same for different isotopes, which was demonstrated by me in the case of the 2537 A line [2] For this reason a correlation based on the intensities, as Schüler and Keyston have done (cadmium, thallium), cannot be considered as convincing

In the case of the line 2537 A, calculations can be made using the isotope concentrations given by Aston, which are not subject to the above mentioned objections, for the life period of different components is known [3] They show that if we attribute the lines 0 and + 11 5 mA to the isotopes 200 and 202 (in arbitrary succession), the three lines represented on Fig 1 must be attributed to two isotopes, 199 and 201 (overlapping of a doublet and a triplet ?), with nuclear moments equal to an odd multiple of 1/2 This last conclusion follows from the fact that in the parallel Zeeman effect the parallel zero components, which show a Paschen Back effect in higher magnetic fields, are not observed

It is curious that the direction of the isotope shift of the lines shown in Fig 2 is opposite to that observed with thallium and to that resulting from the motion of the nucleus around the centre of gravity of the atom This shift has at the same time a relatively high value of c 0 2 cm^{-1} for each addition of two protons, which is, however, nearly a half of the shift observed on the line 5351 A of thallium [1] It is produced probably by the modification of the electric field surrounding the nucleus, as resulting from the addition or subtraction of two protons

A full report of these investigations will be published shortly in the *Bull Acad Polonaise*

S MROZOWSKI

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May 5

[1] H Schüler and J E Keyston, *Die Naturwissenschaften* 19 p 320 1931
[2] S Mrozowski, *Bull Acad Pol*, p 464, 1930 in part also NATURE, 126, p 684, 1930
[3] S Mrozowski *Phys Review*, 37, p 845, 1931
[4] S Mrozowski, *Zeit für Physik*, 68, p 278, 1931

Electron Polarisation

IF the free electron has the spin theoretically assigned to it, the theory [1] of the double scattering of electrons by single stripped nuclei would lead one to expect that when an electron beam impinged successively on two metal targets, the intensity of the secondary scattering would be asymmetric about the direction of incidence of the secondary beam

The majority of the previous experiments to detect this effect have been carried out either with slow electrons (a few hundred volts energy), small scattering angles, or reflectors of low atomic number Under these conditions no observable asymmetry is predicted by theory, and this is in accord with the results of most investigators

Chase [2] has reported that with 90° scattering from 45° lead targets, and with primary electron velocities of from 0 7 to 0 95 the velocity of light, the effect does appear, together with more striking features not predicted by theory With these high velocities, however, the theory loses much of its meaning, since in its formulation the radiative forces on the electron were neglected It seemed desirable, therefore, to look for the effect with a primary electron velocity of such a value that the predicted asymmetry should be easily observable, and yet the radiative forces should be small

The tube was constructed so that the electron beam reflected at 90° from a 45° tungsten polarising target impinged at normal incidence on a tungsten analysing target The intensities of the secondary scattering at an angle of slightly more than 90° could be measured at 0° and 180° of the azimuth without altering any part of the apparatus Only the faster group of electrons in the scattered beams was allowed to reach the measuring instrument, all others being prevented by the use of suitable retarding fields (1700 volts for a primary voltage of 10 kv) Rotation of the polarising target through 180° about the direction of the secondary beam and the use of a second filament at 180° to the first, was intended to reverse the spin asymmetry and to provide a check against possible diffraction effects in the analyser

It was found that with 10 kv and 1 kv electrons the ratio of the intensities at 0° and 180° of the azimuth did not differ by more than the experimental error (1 per cent) For purely nuclear, ideal scattering (in the sense of the Mott theory) the difference should have been approximately 13 per cent This figure is based on the theoretical idea that the probability of an electron being scattered in a given direction depends on the orientation of its spin axis It would therefore attain this value only if all electrons scattered 'into' the polarising target were rediffused with appreciable energy loss, so that the faster group of electrons in the secondary beam would be polarised to the degree predicted by theory

It would appear to follow from this experiment that either the free electron has not the spin theoretically assigned to it, or that the present approximate theory with its neglect of orbital electron scattering and radiative forces predicts an effect which would not appear in a more complete formulation

I am indebted to Prof O W Richardson for the suggestion of the problem

G O LANGSTROTH

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May 8

[1] Mott, *Proc Roy Soc* A, 124 425 1929
[2] *Phy Rev*, 36 1060, 1930

Hyperfine Structure in the Spectrum of Copper

THE principal copper doublet at λλ3248 and 3275 has been studied with great care in the fourth and fifth orders of the large concave grating of the Physical Institute at Tubingen Each line consists of a very sharp, narrow doublet of separation, 0 043 ± 0 001 A or 0 41 ± 0 01 cm^{-1}, the long wave length component being about twice as strong as the short wave length component

Extreme care must be exercised in the photography of this pair of lines They are the 'raies ultimes' of copper, and even when the copper content of the electrodes is so low as 0 001 per cent, the fine structure of the lines indicates the beginning of self reversal A similar phenomenon was noticed by Royds [1] in the green line of thallium

So far as we are aware, the only previous work on the fine structure of these two lines was done by Back [2] with the same apparatus as that used by us On the basis of the present work, it seems that Back's results can be explained by self reversal of the fine structure components It was possible, with 0 001 per cent copper in the electrode and the use of high excitation, to reproduce the results of Back Only when the copper content of the electrode had been reduced, to

a negligible amount (as an electrolytic impurity) and the excitation kept at a minimum did the structure of each of the lines appear as reported in this letter

With a view toward interpreting this hyperfine structure on the basis of nuclear spin, the lines were studied in a magnetic field of 43,350 gausses The Zeeman patterns of these lines have always been reported as simple D types Using very fine grained plates and especial care in development, each of the Zeeman components appears to be doubled, even when using less than 1 per cent copper in the electrodes But this doubling is considerably wider than the field less separation, and we therefore reduced the copper in the alloy (<0 001 per cent) and the excitation to a minimum Under these conditions, the Zeeman patterns of the lines consisted of extremely sharp single lines, showing that the former patterns were probably due to self reversal

The separation 0 41 cm $^{-1}$ can be attributed to the hyperfine structure of the $^2S_{\frac{1}{2}}$ level of copper, since this level is common to both lines The hyperfine structure of the ^2P levels is apparently very much smaller and could not be determined in the present investigation

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[1] Proc Roy Soc 107 A, 360 1925
[2] Ann d Phys, 70 369, 1923

The Velocity of Light

IN NATURE of April 4, p 522, M E J Gheury de Bray pointed out that the decrease of the velocity of light, if it exists at all, could be caused by the change of the earth's magnetic field But such an explanation of a change in the velocity of light could not easily be accepted, because the immediate relation between the velocity of light and the intensity of magnetic field for Maxwell's theory is unknown

Let us suppose that Maxwell's relation for the index of refraction for an insulator $n=\sqrt{\epsilon\mu}$ is correct, μ signifying the permeability and depending in ferro magnetic substances upon the intensity of the magnetic field Then, because the discussion relates to measurements of the velocity of light carried out in air, the change of the velocity of light in the sense of Mr Gheury de Bray's explanation would mean that the permeability, and accordingly the index of refraction of air, had changed (on account of the change of the earth's magnetic field) The index of refraction of air is 1 00029, and a simple calculation shows that within the last fifty years the index should have increased by some $6\ 7 \times 10^{-4}$ in order to produce a decrease of 200 km /sec According to Landolt Börnstein ("Physikalisch chemische Tabellen", vol ii 1923, p 959, I Ergänzungsband, 1927, p 525) it can be seen that this index had not changed between 1865 and 1925, the difference between the various values being $\pm 3\ 6 \times 10^{-6}$, moreover, the values do not show any systematic variation during the time

V S VRKLJAN

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DR VRKLJAN'S contribution to the subject is welcome as tending towards the elucidation of the causes, whatever they may be, which are operative in creating the curious, and possibly significant, refusal of the observational evidences to endorse the theoretical dogma of the constancy of the velocity of light

Dr Vrkljan, however, has misunderstood me I did not express the opinion that a decrease of this velocity could be caused by a variation of the earth's magnetic field I pointed out that the latter no doubt affects the velocity of light and yet that, to my knowledge, no attempt has been made to investigate the relationship and allow for its effect on the observations, although the possible error has been reduced to 1 in 100,000 nearly I further allude at the end of this note to the possible existence of other factors which may also affect the sought value The only correcting factors applied are those for the pressure and temperature of the atmospheric air

The velocity of light is undoubtedly the most important 'constant' in the realm of physical science Theories are currently discussed which admit an expansion of the universe soap bubble fashion, if the ether be material -and there are still physicists who hold this view—such an expansion implies a gradual decrease of density of the ether, and the decrease of velocity of light with time follows as a matter of course To any unprejudiced mind, the observations conclusively put this decrease in evidence If the ether is a mere abstraction, yet its virtual properties must be consistent with the theories which purport to describe the structure of the universe, and therefore there should be somewhere in the scaffolding with which de Sitter's theory has been erected some mathematical counterpart of this particular result of the expansion of the universe, which causes the light to take longer, as time goes on to travel between two points of space defined by their position with respect to the whole, since this whole is expanding, and therefore the distance between these two points increases

I believe that in any other field of inquiry such a discrepancy between observation and theory would be felt intolerable Why it is suffered in the present case is not apparent It is, however, certain that if a decrease of the velocity of light were accepted on theoretical grounds, and if some misguided physicist attempted to demonstrate that it is constant, the present observations would be called to witness to silence him conclusively! Such is the strength of the observational evidence on which this corner stone of physics is actually resting!

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The Conditions on Schrödinger's ψ

THE energy levels of an atomic system are found in wave mechanics by selecting the 'characteristic' solutions of a Schrödinger differential equation, and the conditions defining these solutions are usually stated as an arbitrary mathematical postulate chosen so as to secure agreement with experiment [1] This additional postulate seems to be unnecessary, however, the conditions follow naturally as a consequence of the physical foundations of the theory

Wave mechanics rest upon the following two fundamental laws

(1) ψ has the usual significance of a probability amplitude,

(2) When completely expressed, ψ satisfies always Schrödinger's time equation (or its relativistic substitute)

Characteristic value problems arise as a special case in which the experimental conditions serve to select a system in a 'pure state' as regards some variable, such as energy or angular momentum, which can be 'measured' physically To follow such a measuring process theoretically, one expresses ψ as a series in terms of that complete set of orthogonal character-

istic functions which belongs to the Schrödinger equation for the variable in question, each function corresponding to a certain value of the variable, the measurement can then be regarded as consisting in a physical separation of the terms in this expansion, followed by a detection of the system as being in a place or state corresponding to one of them,[1] in other words, as a generalised Stern Gerlach experiment.

The basic requirement for a characteristic function is accordingly that it shall constitute one of such an orthogonal family in terms of which we can expand any ψ that can occur in Nature. Since it follows from (1) that $\psi\psi^*$ must always be integrable in order that the total probability may be unity, the characteristic functions themselves must be quadratically integrable (or, in the continuous spectrum case, Weyl normalisable). The customary requirements of continuity and single valuedness of ψ or its derivatives are unnecessary as an addition to the fundamental requirement that ψ shall satisfy a certain differential equation. The condition that ψ shall be finite everywhere, which serves so well in atomic theory, is in almost all cases equivalent to the requirement that $\psi\psi^*$ shall be integrable. The possibility remains open, however, that in exceptional cases infinities may occur without destroying the integrability, as in the Dirac relativistic hydrogen atom,[3] and on this view such an infinity does not necessarily constitute a 'blemish' on the theory.

The basic postulates of quantum mechanics are necessarily somewhat abstract but when we have a choice, I feel that the less abstract form has decided advantages from the physical point of view.

E H KENNARD

Cornell University,
Ithaca, New York,
April 27

[1] Cf Joffé *Zeit f Physik* **66** 770 1930 Langer and Rosen *Phys Rev* **37** 658 1930
[2] Cf for example *Phys Rev* **31** 876 1928
[3] Darwin, *Roy Soc Proc*, **118**, 673 1928

An Apparatus for Recording the Ultra-Violet Light of the Sky

OBSERVATIONS of ultra violet light are being made in many towns and seaside resorts by means of Sir Leonard Hill's method of recording the fading of a solution of methylene blue in acetone. For simplicity it would be difficult to improve upon this procedure, but in winter, when the days are short, there are many times when the fading is too small to be observable by this method.

Experiments have been carried on here during the last year or two on an alternative method in which photographic printing paper is used to register the ultra violet rays.

A strip, 3 in × 1 in, of 'Ultra violet Glass', which is opaque to visible light but allows a band of rays beyond the violet from about 3400 to 3700 angstrom units to pass, is fitted into a slot 3 in × 1 in, in the lid of a shallow metal box, so that the interior of the box is illuminated only with ultra violet rays when the lid is closed. To measure the intensity of these rays a stepped 'wedge' is constructed of layers of a fine quality of thin tissue paper which provide ten grades of thicknesses through which the light may pass. A strip of photographic paper receives the ultra violet rays. This paper is laid on the bottom of the box, the wedge is put over it, the lid of the box closed, and the whole exposed to the light of the sky. At the end of the day the photographic paper is examined, and the greatest number of layers of paper in the wedge which the light has penetrated is read off. According to theory, this number is the logarithm of the intensity of the light. The transmission factor of the paper being known, it is easy to construct an arbitrary scale of light values.

The method is sensitive enough to allow a daily reading to be obtained all through the short days of winter except at such times when fog obscures light of every kind.

As the year advances from winter to summer and the light becomes stronger the wedge scale may need extending, and in that case a further suitable number of layers of the tissue paper may be superimposed on the wedge without detriment to the accuracy of the readings.

If necessary this photographic method could easily be adapted to give a continuous record of ultra violet rays by wrapping the photographic paper on a rotating drum.

The record of average monthly readings with this apparatus compares very well with the monthly averages of the methylene blue apparatus.

Observations are being carried on in Manchester, Rochdale and Hale (Cheshire), and they show a regular diminution of ultra violet light as we pass from the open country, through the suburbs, to the centre of a manufacturing town, where the light is found to be about one half of what is received in the country.

This is no doubt, due to smoke in the atmosphere, for direct experiments in the laboratory demonstrate that smoke is effective in obscuring ultra violet rays.

J R ASHWORTH

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Rochdale,
May 8

The Change of Density of Nitrobenzene with Temperature

IN connexion with the study of the dielectric constant of nitrobenzene as a function of temperature,[1] I have measured the density of nitrobenzene in the temperature interval between 5.6° C and 30° C, using the method described by H Kamerlingh Onnes and J D A Boks.[2]

I have already used this method in measuring the dependence of the density of ethyl ether upon temperature,[3] there is therefore no need to dwell upon the details. I will mention only that temperatures were determined with an error not greater than 0.003° C, the changes in the fourth or even fifth decimal of the value of density were still discernible.

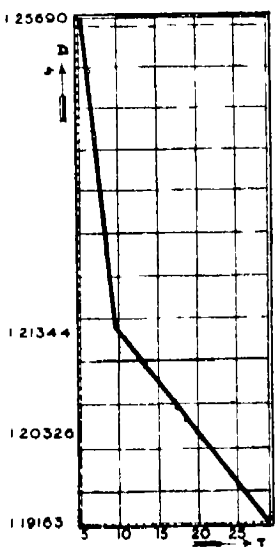

FIG 1

The density of chemically specially purified nitrobenzene increases from 1.1916 at 29° C up to 1.2134 at 9.8°. Beginning from 9.5°, there is a markedly more rapid increase of density with the lowering of temperature, at 5.5°, that is, in the neighbourhood of the freezing point, the value of the density is 1.2569. These changes of density appear distinctly on the accompanying graph (Fig 1).

In the neighbourhood of 9.5° there is a sharp change

of slope of the curve This temperature was incorrectly held by many authors to be the freezing point [4] In the present study I have definitely found that the freezing point is at 5 5°, at 5 7° nitrobenzene is distinctly liquid

It is to be noted that the slope in the density temperature graph is the more interesting because at the same temperature of 9 5° the dielectric constant of nitrobenzene, as was shown previously by me, shows a very sharp decrease Both this sharp change of the value of dielectric constant and the sharp change of slope in the density curve in the neighbourhood of 9 5° lead to the assumption that at this point nitrobenzene undergoes some, as yet not clearly understood, energy transformation

J MAZUR

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April 4

[1] NATURE, **126**, 993, Dec 27 1930, and *C R Sci Soc Polon de Physique* **5** 3 1931

[2] *Comm Leiden*, No 170b

[3] NATURE **127** 270, Feb 21 1931 and *C R Sci Soc Polon de Physique*, **5** 4 1931

[4] Landolt und Börnstein, Tabellen

The Effect of X-Rays on Hair

IN NATURE of May 2, Messrs Asprey and Woods, writing on the subject of the molecular weights of proteins, mention that they have recently been doing some work on the effect of X rays on the elastic and other properties of animal hair They state that, after exposing unstretched wool for sixty hours to the full beam of a Shearer X ray tube, the fibres show many of the properties characteristic of wool which has been exposed in a stretched state to the action of steam They refer the effect to the disruptive action of high energy quanta on the length and adhesion of peptide chains, and mention that it must be closely related to the influence of various radiations on biological activity

The accompanying photograph (Fig 1) may be of

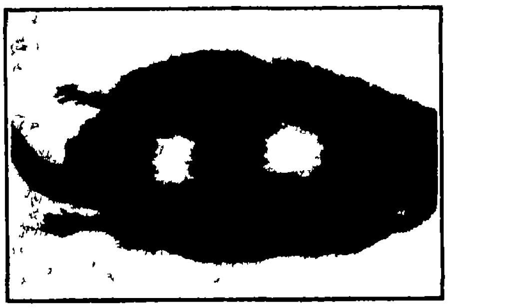

FIG 1

interest in this connexion, and is one which I showed a few years ago at a joint meeting of the Physical and Röntgen Societies The photograph is of a black rat which has been exposed over two small areas of the back to X rays generated in the region of about 150 kilovolts Some weeks after the dose had been given, the hair fell out and the new hair which grew was devoid of pigment and considerably altered in texture, the normal straight hair of the animal being changed to a rather thinner fibre which appeared slightly curly This result must, of course, be attributed to some action of the radiation upon the hair follicles, and the curliness of hair which regrows, once the surface has been epilated, is a not uncommon observation in children where epilation of all the hair of the head has been purposely brought about The doses in the cases mentioned are probably many times smaller than those mentioned by the authors

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Stellar Structure

BY an unaccountable slip, a numerical error crept into our recent communication [1] concerning the nuclei of planetary nebulæ With the assumed data for a typical nucleus, it is the superficial area which is 1/43 of the sun's With mass equal to the sun, the mean density comes out 400 gm /cm [3], and with the probable mass 80 suns, as 32,000 gm /cm [3] This is still high enough to justify the classification of these stars with the white dwarfs, but degeneracy of the gas appears to be only beginning, rather than far advanced

The suggestion that the nuclei of planetary nebulæ are of high density and comparable in physical condition to the white dwarfs was made by Prof D H Menzel,[2] who gave convincing arguments in favour of his position We regret that we did not notice this in time to mention it in our letter

The subject has also now been dealt with by Gerasimovič [3] It seems possible that further additions to the list of 'white' dwarfs which we gave may be made from among the *O* and *B* stars, in accordance with the suggestion of K F Bottlinger [4]

HENRY NORRIS RUSSELL
R D'E ATKINSON

Princeton University,
Princeton, New Jersey,
May 25

[1] NATURE, May 2 p 661

[2] *Publications Astron Soc Pac*, **38** 302 1926

[3] *The Observatory* April

[4] *Zeits f Astrophysik*, **2**, p 153 1931

University Representation

'UNFORTUNATELY, the case of the universities has been weakened by their own action in selecting members according to their political complexion rather than for their intellectual stature" (News and Views, NATURE, May 30)

The abolition of plural voting will inevitably result in a decrease (which may be considerable) in the number of votes cast in university constituencies The *Times* has represented the expected neglect of the university vote as virtual extinction Voting will tend to be left to those whose interest in the representation of 'stature' is strongest, and the ordinary politically minded voter with a degree may easily be in the minority

Is there no organisation adapted to turning this situation to advantage? The special opportunity seems to be this The assumed majority will be compact, relatively small, and accessible Its members, with special national needs in mind, should be prepared to excuse their representatives from attendance on those occasions when Parliament is pursuing what many of us regard as the merely political game The universities' representatives need not, therefore, find their work unduly heavy, although it might for some time be discouragingly light

TUDOR JONES

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The Nomenclature of Petrology and Mining

By SIR RICHARD REDMAYNE, K.C.B.

NOMENCLATURE in the scientific sense may best be described as a system of technical language by which the objects of any science are described, as, for example, the present language of chemical science, usually termed the modern chemical nomenclature, as distinct from the older and less perfect nomenclature. Consideration is here restricted to nomenclature in relation to petrology and mining, and to emphasising the desirability of working to secure a uniform and simple system in respect thereof, for the variety and complexity prevailing in petrological and mining nomenclature are very considerable and hampering.

A first step towards international universality of definition and name would be to secure unanimity of name, meaning, and notation nationally. Great diversity exists at present, especially in the domain of petrology—a state of disorder which is constantly increasing with the growth of terms and expressions. As demonstrating the doubtfulness or inconclusiveness which persists in petrological definition, one may take such well-known words as ‘freestone’, ‘coal’, ‘lignite’, and ‘ore’, all terms in very common use in petrological and mining literature. We find that such diversity of definition exists in regard to these as almost to amount to chaos. For example, in the county of Durham the term ‘freestone’ is applied to sandstone only, but in the West Riding of Yorkshire, to limestone. Albert H. Fay, of the Department of the Interior, United States of America, in his “Glossary of the Mining and Mineral Industry, 1920”, describes freestone as ‘any stone, especially a sandstone, that may be cut freely in any direction without a tendency to split”, which is perhaps as good and workable a definition as could be devised.

In considering the implication of the term ‘coal’ we are met with a great variety of meanings. Holmes defines coal deposits as a “general name applied to black carbonaceous deposits, derived from accumulations of vegetable debris which have been compacted by diagenesis into firm brittle rocks exhibiting a dull or shining lustre.” Fay's description is not in entire agreement with this—the reason perhaps being due to a difference of definition of ‘lignite’—for he defines coal as “a carbonaceous substance formed from the remains of vegetation by partial decomposition (U.S. Geol. Surv.). A solid and more or less distinctly stratified carbonaceous substance varying in colour from dark brown to black, brittle, combustible, and used as fuel, not fusible without decomposition, and very insoluble. In its formation the vegetable matter appears to have first taken the form of peat, then lignite, and finally bituminous coal. The latter by loss of bitumen has in some places been converted into anthracite or hard coal. Lignite gives a brown powder, coal a black; lignites contain a large percentage of water and ash.”

Here we have an example of the danger of tacking on a description to a definition. The description, as well as the definition, bristles with debatable matter. The stages of formation as set out are by no means agreed; the fact that there is loss of volatile hydrocarbons in coal on the application of heat does not prove that these hydrocarbons exist in the coal in the form of bitumen, bitumen being composed of solid or semi-solid hydrocarbons. Some true coals, again, contain a higher percentage of ash and of moisture than some lignites.

The term ‘lignite’ is used very loosely. Commonly, all immature coals are called lignite. It is used to embrace not only true lignites, but brown coals also. According to Holmes, lignite is distinguished from brown coal by containing more than 20 per cent of water, but this is not so. Brown coals are known which contain considerably more than 20 per cent of moisture and some lignites which contain less than that amount. As a matter of fact, lignite is immature coal formed from wood—it is found in brown coal deposits—whereas brown coal has earthy characteristics and probably owes its origin to peat, and lignite to the trees which grew where the peat was formed. The term best applied to those so-called black lignites which approximate to true coal—and there are many of them—is that adopted by the United States Geological Survey, ‘sub-bituminous’ coal.

The importance of a correct definition of ‘coal’ from a legal point of view alone is very great. The mineral mined at Torbane Hill, in Scotland, will be remembered in this connexion. It was this mineral which Mr. Young first used, in 1856, for the extraction of paraffin oil, which gave the start to mineral oil lamps in Great Britain and was extensively exported to the United States of America. The distillation of oil from this mineral led to much litigation. The great question was whether this mineral was or was not coal. The bulk of the evidence went to prove that it was not coal but a bituminous shale or clay. However, the use of the term ‘coal’ was retained. The litigation was in part between Mr. Young and the distillers of oil from cannel in England and the producers of petroleum in America, and in part with the owners of the ground from which the mineral was taken.

A commonly accepted definition of ‘ore’ is “a metalliferous mineral of economic value”, and of ‘ore deposit’ “a rock containing a metalliferous mineral of economic value in such amount that it can be profitably exploited.” But these definitions are inadequate and unsatisfactory, for there are ores and ore deposits which, by reason of poverty of metalliferous mineral contained in them, or for other obvious reasons such as difficulty of transport, cannot be profitably exploited at the present time, but may, on the exhaustion of richer deposits and on improvement in transport, be brought

within the category of profitability A better definition of ore would be "A metalliferous mineral of economic interest", or Crook's definition in his work on mineralogy, namely, "A metalliferous mineral which owes its economic value to the fact that it is smelted or otherwise treated to obtain a metal"

Various attempts have been made from time to time to standardise geological nomenclature, notably at the Congrès Géologique International in Paris in 1901, which, however, succeeded only in showing the wide divergence of opinion existing in that respect, and at which no final decisions were made Holmes, in his book, "The Nomenclature of Petrology", has taken stock of the situation and recorded the existing nomenclature in accordance with its current usage in so far as Britain is concerned The introduction to this work contains an excellent résumé of the question in relation to petrology With regard to his statement, "at the present time the field of petrology still contains many uncultivated corners, and, until the whole has become familiar ground, existing systems of classification and nomenclature must be regarded as on probation", there must be general agreement, but there will be considerable divergence of opinion concerning his belief that "stability will be approached not principally as a result of any Committee, international or sectional, but by the co ordinating work of a single petrological genius, whose authority, the outcome of his own success and influence, will be far superior to the merely temporary and democratic authority of a Committee" It seems to the present writer that a most useful end would be served by setting up, in the first instance, national committees with the object of securing, nationally, uniformity and simplification in naming and classification, and thereafter by an international committee, compounded of representation from the national committees, proceeding to deal with the subject internationally Perhaps the aid of the League of Nations might, with advantage, be invoked in this connexion

In regard to mining, except to the extent where the law has stepped in to regulate the industry and thereby brought about accuracy, clarity, and standardisation of definition, the terminology is varied, unsatisfactory, and often chaotic For example, the simple word 'pit' is applied indiscriminately to indicate a shaft, or a colliery with two or more shafts or pits and sometimes even to a mine worked by adits Then, again, the word 'colliery' is used to denote one unit or a collection of units of production under the same management In respect to these, the French nomenclature is better than ours Another example is the diversity which exists regarding the terminology applied to a bed of coal 'Seam' is the word used in the north of England, 'mine' in Staffordshire, and 'vein' in Wales Then the 'floor' of a seam is termed 'pavement' in Scotland and 'thill' in Durham and Northumberland These and many other examples show the advisability of agreeing among ourselves as to mining nomenclature before entering upon an international conclave, and that when we do discuss the subject internationally we do so in the first instance on broad and simple lines Agreement is far more likely to be reached if we do not strain at attaining too much in the first instance What is meant by this will be made clear by the following example

Hitherto it has been impossible to institute proper statistical comparisons between different countries, or make correct deductions in regard to output, consumption, and value of minerals, by reason of the absence of uniformity in statistical records It was in consequence of this that the Imperial Mineral Resources Bureau,* in the year 1924, drew up a statement of what it conceived to be the essential requirements regarding statistical returns from different parts of the British Empire Thereafter it engaged upon the work of drafting skeleton forms in which returns should be made in order to meet requirements in the light of the criticisms which the Bureau had received These forms were submitted to various government departments of Great Britain and the Dominions, India, and the Crown Colonies for criticism and comments, and the forms redrafted to meet the greatest common measure of agreement, being then passed to the economic statistical branch of the League of Nations

The ultimate end sought to be reached by the Bureau was an ambitious one, namely, to obtain, in respect of each country, statistical returns as to (*a*) production, (*b*) exports, (*c*) imports, (*d*) consumption, (*e*) value, (*f*) persons employed at mines and quarries, (*g*) accidents and health, and where possible (*h*) cost of production, (*i*) wages, (*j*) workmen's compensation It was realised, however, that it was not possible to obtain complete and uniform statistics under all these heads

It must be remembered that in connexion with returns of production and value, these are in many cases given voluntarily to government departments by the mine owners Thus, in Great Britain in the case of minerals, under the Metalliferous Mines Act the return of mineral sold is of a voluntary character, whereas in the case of coal the returns as to production and value are compulsory The variations in respect of weight are very great even with English speaking nations, the ton sometimes termed the long ton (2240 lb), the short ton (2000 lb), and the metric ton (2204 62 lb) being in use The Bureau suggested that within the Empire the long ton should be used, except in certain cases such as the precious metals, in which the usual practice should be followed of giving the weight in troy ounces

The views of the Imperial Mineral Resources Bureau have been very largely accepted by the International Convention on Economic Statistics held at Geneva in 1928, which in itself must be regarded as a notable achievement, but it now remains for the several countries to implement and bring into effective operation the decision of their representatives This has not yet been done, though more than two years have passed since the date of the Convention

* Now the Mineral Department of the Imperial Institute

Dietary Surveys

SOME account was recently given in these columns (NATURE, vol 126, p 963, 1930) of the results of studies of human dietaries in Scotland and the United States of America In both, it appeared that the caloric consumption was usually adequate, but that the intake of protein and minerals was frequently below the standard In all such studies, it is usual to take as standards figures which have been obtained in earlier investigations including experiments on metabolism, but it does not necessarily follow that these figures are applicable to people accustomed to a manner of living different from that under which they were originally obtained Careful studies, therefore, of the actual food consumption of families in different classes of society may not only point to dietary deficiencies but also to the necessity of revising our ideas of the adequacy of a diet This does not imply that previous investigations have given erroneous results, but merely that a different standard may be necessary when the food ordinarily preferred or available differs according to the customs of the people studied

To increase our knowledge of the actual food consumption of the inhabitants of Great Britain, Cathcart and Murray undertook an inquiry into the diet of a number of families in St Andrews[1] All classes, rich and poor, were included in the study, which comprised 745 persons, or one thirteenth of the total population The diet of each family was obtained for a period of one week by a skilled investigator and the energy value and distribution of the calories between protein, fat and carbohydrate, as well as the amount of money spent, determined No attempt was made to investigate the mineral or vitamin intake, the study being confined to the quantitative rather than the qualitative aspect of nutrition In all such work it is necessary to express the food requirements of women and children as a fraction of that of a man the total gives the 'man' value for the family The figures actually used were based on those given by Lusk and Atwater At the same time, it is also necessary in a week's study to make allowances for absences from meals or the presence of guests The 'man' value per family in this investigation was 3 37 and the 'diet man' value 3 51 The correctness or otherwise of the coefficients used for the 'man' value of women and children will be discussed later

The average of all the figures showed a caloric consumption of 3119 per man per diem, obtained from 89 gm protein, 119 gm fat, and 411 gm carbohydrate, the distribution of the calories between the proximate principles being 11 per cent from protein, 35 per cent from fat, and 54 per cent from carbohydrate These figures agree with those obtained previously in Great Britain and the United States, but differ from those of the standard diets of Voit and Rubner in the smaller consumption of protein and the much greater intake of fat This variation appears to be a national characteristic and has little relationship to income, occupation, social standing, or season

Thus, when the families were grouped according to total weekly income, it was found that the caloric intake per man was greater the higher the income, the increased calories were obtained chiefly from fat and to a lesser extent from protein The latter accounted for 11 per cent of the total in all groups, so that the low consumption of this dietary constituent appears to be due to choice and not necessity It was also clear that the number of calories obtained per penny spent increased as the income of the family fell

When the families were arranged according to their occupation, it was found that the sedentary worker consumed more food than the artisan As obesity is not common among the well to do, the excess calories must be metabolised, probably in part by the normal metabolism and nutrition being at a higher level than in the poorer sections of the population and in part by the habit of violent exercise Comparison of the diets of families of the same occupation showed that they varied considerably, apparently from variations in taste and appetite

The adequacy of a family diet is reflected in the state of nutrition of the children, which was found in this study to be usually satisfactory, in fact, in the better-class families the children were above standard and only in those of the unemployed were they below The variations from standard affected the height more than the weight, and the authors consider it probable that hereditary influences play a very considerable part in the subnormality of the children of the unemployed, as in the greater height of those of the better class families

One other point must be referred to the man value' coefficient implies that all members of the household vary their caloric intake in accordance with the value given to the man, this is probably not correct, and the point is of considerable importance when the diet is at the lower level of adequacy Examination of the actual food consumed by the different members of a few families showed that the man might consume 12 per cent more calories than was indicated by the 'man value' figure, made up from a 19 per cent increase in the protein and a 25 per cent increase in the fat intake, the mother, on the contrary, obtained the bulk of her calories from carbohydrate As a result of this work, a new set of family coefficients is tentatively proposed, somewhat lower in general than those actually used in this research

It may be of interest to refer briefly to another dietary study carried out under very different circumstances on another race[2] The natives of Nigeria studied have a high death rate and a low birth-rate with an almost stationary population they are undernourished, being below the white standard in both height and weight, they show a low resistance to disease, anæmia and intestinal toxæmia are common, and epidemics take a severe toll The staple diet consists of two cereals, guinea corn and pearl millet, with varying amounts of green leaves, fruit, partly cooked meat, sour milk,

and ground-nut oil The diet is deficient in protein, salts, especially calcium and iron[2] and vitamins Biochemical investigations showed that the blood sugar was above and the serum calcium below the generally accepted standards the urea and chloride output in the urine were low, indicating a subnormal consumption of protein and chlorine The protein intake was of the order of 85 gm per diem, whereas with such biologically poor proteins as those from guinea corn and millet, at least 110 120 gm should be considered the minimum necessary It may be pointed out that the total amount of protein consumed by the Hausa is about the same as that taken by the population of St Andrews, but the latter obtain their supply from both animal and vegetable sources, whereas the former utilise mainly cereal proteins of poor biological value McCulloch makes several recommendations for improving the diet of the Hausa more milk should be drunk and the breed of cattle improved by supplementing the deficiencies in their diet, the protein of the ground-nut should be eaten and not discarded as at present, 15-25 per cent ground nut flour, containing not more than 5 per cent oil, being added to the ordinary flours used, the salt consumed should contain small amounts of iodine, and the consumption of green leaves should be increased By these means, the protein, salt, and vitamin deficiencies could be overcome and the nutrition and resistance to disease of the population markedly improved, without any great interference with their present dietary habits

[1] Medical Research Council Special Report Series, No 151 A Study in Nutrition an inquiry into the diet of 154 families of St Andrews By E P Cathcart and A M T Murray, assisted by Miss M Shanks (London H M Stationery Office, 1931) 1s net

[2] An inquiry into the dietaries of the Hausas and Town Fulani of Northern Nigeria with some observations of the effects on the national health, with recommendations arising therefrom By Dr W E McCulloch *West African Medical Journal*, vol 3, 1929–30

James Clerk Maxwell, 1831–1879

IN the history of science, names such as those of Galileo, Newton, Faraday, Darwin, Helmholtz, and Kelvin stand out like the peaks of a great range of mountains amid the surrounding lesser heights One such name is that of Maxwell, the centenary of whose birth falls on June 13, and to whose memory homage will be paid at Cambridge in October by Profs Einstein, Planck, Langevin, and others Maxwell's work belongs to the third quarter of the nineteenth century, and fifty eight years have now passed since the appearance of his "Treatise on Electricity and Magnetism", but the passing of time has shown much of his work to be of fundamental importance, and there is no investigator of physical subjects who does not owe something to him He died at the age of forty-eight, when in the prime of life, a man loved and honoured by all who knew him, for the kindliness of his disposition and the charm of his character Of his writings, it has been said that every one of them is stamped with the subtle and unmistakable impress of genius

Maxwell was born in Edinburgh and was an only son His mother died in 1839 and his father in 1856 The family name was originally Clerk, to which Maxwell had been added, thus becoming Clerk Maxwell, but while this is the correct form, it is by the second of the names that Maxwell is generally known Without the remarkable precocity of Young or Rowan Hamilton, Maxwell showed the possession of unusual powers at an early age, and as a schoolboy attending Edinburgh Academy he wrote a paper on oval curves At the age of sixteen he entered the University of Edinburgh, being taught mathematics by Kelland, physics by J D Forbes, and logic by Sir William Hamilton Three years later he left Edinburgh for Cambridge, where, after a term spent at Peterhouse, he entered Trinity College, having Hopkins as tutor In 1854 he graduated as second wrangler and Smith's prize-man, Routh being senior wrangler and tying with him for the Smith's Prize In October the following year, Maxwell was made a fellow of Trinity College, and in December published his first paper, on "Faraday's Lines of Force", a subject which was to engross much of his attention for the rest of his life

From Cambridge, Maxwell went first to Marischal College, Aberdeen, and then to King's College, London, holding in both institutions the chair of natural philosophy Four years were spent in Aberdeen and five in London, and to those years belong his memoirs on colours and colour-blindness, on the dynamical theory of gases, on the motion of Saturn's rings, and also his classic paper on a "Dynamical Theory of the Electro magnetic Field", read to the Royal Society on Dec 8, 1864 It was this paper to which the attention of Hertz was called by Helmholtz, just when Hertz was on the threshold of his fruitful investigations of electro-magnetic waves

From London, in 1865, Maxwell, who had suffered from serious illness, retired to his estate in Dumfriesshire—only, however, at the end of about five years to become the first professor of experimental physics at Cambridge His inaugural lecture was delivered on Oct 25, 1871, and on June 16, 1874, the now famous Cavendish Laboratory, erected by the seventh Duke of Devonshire, then Chancellor of the University, was opened Maxwell's great "Treatise on Electricity and Magnetism", "one of the most splendid monuments ever raised by the genius of a single individual", was published in 1873, in 1878 he delivered the Rede Lecture, and just before his death, which occurred at Cambridge on Nov 5, 1879, he had completed the editing of the electrical researches of his great forerunner, Henry Cavendish "The Life of Maxwell", by Campbell and Garnett, appeared in 1882, his "Scientific Papers", edited by Niven, in 1890, and in 1896, Sir Richard Glazebrook published his book "Clerk-Maxwell and Modern Physics" To Sir Richard Glazebrook we also owe the account of Maxwell in the "Dictionary of National Biography"

Obituary

PROF RAOUL GAUTIER

SCIENCE has lost a distinguished member, and English geodesists and astronomers a friend, in Raoul Gautier, who died on April 19, at Geneva

Raoul Gautier came of a family which has served Swiss and international science for many years We find Jean Gautier, for example, professor of philosophy and physics at the University of Geneva in the beginning of the eighteenth century An account of his observation of the eclipse of the sun in 1706 appears in *Philosophical Transactions* (vol 25, No 306, pp 2241-2246) In the early years of the nineteenth century another Gautier, Jean Alfred, was beginning to make his name as an astronomer To him is due the present Geneva Observatory built in 1830, although Arago seems to have shared to some extent the responsibility for it, in so far as his comments on the previous observatory did not lack candour In 1842, Émile Gautier was collaborating with Airy in the observation of another eclipse We hear of Émile in London, Oxford, and Cambridge He is not, perhaps, the only one who records a disinclination "pour parler d'affaires" after an excellent lunch in Trinity In 1883, after a truly international training, he took charge of the Observatory, and he is, perhaps, as well known as a meteorologist as an astronomer A point which impressed his countrymen, as well as his foreign colleagues, was that humanity and helpful understanding which stood both himself and his wife in such good stead during his term of office

Raoul, their son, was born in 1854 His education was singularly complete on the physical as well as on the mental side He travelled early, learnt English and German when young, and studied the classics, as well as mathematics, anatomy, and zoology He was a fencer, a mountaineer, and a horseman He became a man of the world with a singular charm of manner, at the same time as he laid the foundation of his scientific career When master of arts, he took up the family tradition of astronomy

Five years at Leipzig, education and friendship from Bruhns, Frederic Zoellner, Neumann, and other mathematicians, a visit to Uppsala, where Struve presided over a meeting of the Astronomische Gesellschaft, and where he met Gylden, Schönfeld, and Backlund, began to polish the expert Gautier's first essay in journalism was a report for the *Journal de Genève* on this Uppsala meeting His next undertaking was a study of planetary orbits (an inherited taste), and it was certainly a 'gros travail' to observe, to compute, and to analyse the facts that led to the publication of "La Comète périodique de Tempel 1867 II, étude consacrée spécialement aux apparitions de 1873 et de 1879"

This planet was not altogether a happy one for Gautier The strain of calculation brought him his doctor's degree, but cost him two years of enforced rest In 1885, we find him once more engaged in wrestling with the considerable influence of Jupiter's neighbourhood upon the same planet *Astronomische Nachrichten*, the *Comptes rendus*, and *Archives des Sciences physiques et naturelles* contain the results of his labours on the hoped for reappearances of 1892, 1898, and 1905 Unfortunately, the planet did not reappear

In the 'eighties, Gautier frequently visited the Neuchatel Observatory to work with its director, Hirsch In 1887, Gautier secured his doctor's degree in mathematical science At thirty three years of age, with three children, and three branches of mathematical science in which to qualify, Gautier confessed to a lack of that elasticity one expects of twenty, but he secured his degree, and in 1889 succeeded to the chair of astronomy and the directorship of the Geneva Observatory In 1885, he was given the chair of physical geography, re-established in that year after a period of eclipse We find him more interested perhaps in meteorology and oceanography than in morphology At this time, Gautier was professor at the University, secretary of the faculty of science, and secretary of the senate He was Vice Rector of the University from 1916 until 1918, and Rector from 1918 until 1920

An evidence of Gautier's activities in the 'nineties is contained in "Le Service chronométrique à l'Observatoire de Genève et les concours de Geneve avec une étude des épreuves instituées dans d'autres observatoires" This side of his work has found recent expression in the new Salle des Chronomètres (1924)

In 1900, Gautier observed the eclipse in Algeria, and in 1905 was with Sir Norman Lockyer in Majorca, where they had the mortification of finding bad weather whilst Algeria remained clear and fine In 1908, important spectroscopic observations on Morehouse's comet, and in 1909-10 Halley's comet, must have brought him back, with satisfaction, to his first love, whilst Nova Persei, Nova Aquilæ, and Nova Cygni he found "fort intéressantes"

As a meteorologist, Gautier began to install new apparatus in the Geneva Observatory in 1897 For many years he was engaged in the study and comparison of meteorological observations, prior to 1926, made in the vicinity of Geneva 1912 was almost wholly devoted to this end, and his results —not, unfortunately, final—are given in *Archives*, vols 31 and 32 His interest in meteorological observation at the Great St Bernard (where he installed a Fuess barometer in 1903) and his arrangements for pilot balloon observation will not be forgotten, nor will his services in the creation of the observatory at the Jungfraujoch In this latter enterprise he was able to count upon the generosity of fellow townsmen, who knew how to appreciate his services and contribute to his undertakings Gautier must have felt his retirement in 1928, but he was confident in his successor, and glad, in a measure, to relax the strain His public services had been great He was consecutively member, secretary, and head of the Swiss Geodetic Commission An active member of the old International Geodetic Association, he worked with Ferrero, Bakhuysen,

Arrillaga, and Helmert Copenhagen, Budapest, London, and Cambridge saw him at their meetings It was at the London Conference of 1909 that he first became well known to British geodesists Those of us who recall that Conference, at which Baron Eötvös also first made himself generally known, look back with regret on his manly figure and peculiar charm During the War, he acted as president of that geodetic association of neutral countries which helped to keep international enterprise alive In 1920, he was chosen to represent his country on the International Geodetic and Geophysical Union We met him at Rome, at Madrid, and at Prague, and the memory we shall retain of him is that of a courteous, statesman like gentleman whose ripe judgment and unfailing interest were of quite exceptional value to the Union

Gautier was elected vice president of the Geodetic Section of the Union in 1922 He was president of the Swiss National Committee for Geodesy and Geophysics, president of the federal meteorological committee, and a member of the international committee of weights and measures It does not surprise one that he was also the chief engineer of the 1st Corps of the Swiss Army We bid good bye, then, to as versatile a man as modern science can show, and to one whose peculiar social and administrative gifts were of the greatest help in any international gathering

DR FREDERICK MUIR

IN the death of Dr F Muir, which occurred on May 13, entomology loses one of its keenest and most experienced devotees Born in 1872, Frederick A G Muir served in his early life with the Eastern Telegraph Company and was stationed during different times at various localities on the eastern shores of Africa and also at Aden

Being an ardent entomologist from boyhood, Muir's tropical experience broadened and intensified his great natural ability as a student of insect life It was while he was still in the telegraph service that he first came into touch with the late Dr David Sharp In 1905 it was through Dr Sharp's influence that Muir adopted entomology as a profession and joined the scientific staff of the Hawaiian Sugar Planters' Association in Honolulu The worst troubles of the sugar cane growers in the Hawaiian Islands were imported insect pests, and it fell to Muir to explore many lands in order to discover the native countries of these pests, with the object of investigating their indigenous enemies In this work Muir made repeated and often extremely arduous journeys to such lands as Japan, China, the Philippines, Formosa, the East Indies, Queensland, and other parts

Few naturalists of recent years have had the same intimate knowledge of the Malay Archipelago as Muir His duties took him on more than one occasion to Java, New Guinea, Amboina, Ceram, and other of the islands, where he had to face hardship and sickness, and to work under improvised conditions of the most primitive kind Muir fortunately lived to see the results of his work on biological control bear abundant fruit The predaceous Capsid bug *Cyrtorhinus mundulus* discovered by him in Fiji and Australia in 1919 was the agent which finally achieved complete economic control over the sugar-cane leafhopper His work on the Tachinid fly, *Ceromasia sphenophori*, which after much journeying, he eventually obtained in New Guinea, has been the major factor in the subjugation of the cane borer weevil Perhaps his most striking success in the field of biological control was his introduction of the solitary wasp *Scolia manilæ* from the Philippines into the Hawaiian Islands, in 1916, where it achieved, in a remarkably short time, a high degree of control over the *Anomala* beetle

Muir's pioneer work in the field of biological control has had an enormous influence over the prosperity of the Hawaiian Islands, where his name is very widely known His interest in entomology, however, covered almost all fields of the subject On the taxonomic side he became the recognised authority on the difficult group of the Fulgoroidea His skill in minute dissection led him to explore various aspects of morphology, and his fundamental study, in conjunction with Dr David Sharp, on the genitalia of Coleoptera is a standard monograph In his travels Muir had little opportunity to publish, and his many papers were mostly written during periods at headquarters or while on leave In the few years of his retirement at Warnham, in Sussex, he took full advantage of the opportunity for unfettered research Severe illnesses, however, incapacitated him for much of the time but his optimism led him to plan work for the future Long subjection to tropical conditions unquestionably sowed the seed of illnesses that led to his premature death One of the last published contributions from his pen was in the form of a letter, dated May 11, entitled "Disease in Nature", which appeared in these columns so recently as May 23

At the time of his death, Muir was still a member of the scientific staff of the Hawaiian Sugar Planters' Association, his services being retained in a consultative capacity In 1918 he married Miss Margaret Anne Sharp, third daughter of Dr David Sharp, and leaves one son A few years ago he received the honorary degree of D Sc from the University of Hawaii, and in 1930–31 he was a member of the council of the Entomological Society of London, being a vice president for the year 1930

A D I

WE regret to announce the following deaths

Prof I P Church, emeritus professor of civil engineering at Cornell University, on May 7, aged eighty years

Prof Louis Dollo, professor of geography and animal palæontology in the University of Brussels and curator of the Royal Museum of Natural History, on April 19, aged seventy four years

Mr T T Gray, president of the Gray Laboratories of Newark, New Jersey, known for his work in petroleum technology, on April 27, aged forty nine years

Mr C T Heycock, F R S, Goldsmiths' reader in metallurgy in the University of Cambridge and Prime Warden of the Goldsmiths' Company in 1922, on June 3, aged seventy two years

News and Views

DR C DAVISON, author of "A History of British Earthquakes" and other important works on seismology, writes "With the reports of the first day only before us, it is difficult to give a satisfactory account of the greatest earthquake that is known to have disturbed Great Britain, on June 7 It is clear from them, however, that the earthquake was not of British origin, and it is fortunate indeed that the epicentre of so strong a shock lay far out in the North Sea For the exact position of the centre or of the region from which the first vibrations proceeded, we must rely almost entirely on seismographic evidence Some slight damage, such as the fracture or overthrow of a few chimney stacks, occurred at several places in the east of Yorkshire, such as Filey, Bridlington, Beverley, and Hull, at a few in the north of Norfolk, such as Wighton (near Wells), Cromer, and Sheringham With materials so scanty, it is impossible to fix the epicentre with precision, but it may lie about lat 54° N, long $2\frac{1}{2}$° E, or about 115 miles east of Hornsea in Lincolnshire"

"THE area over which the shock was felt includes quite half of Scotland from Elgin on the north, the Isle of Man, the whole of Wales with the exception perhaps of Pembrokeshire and Carmarthenshire, and all England but Cornwall, Devon, and part of Somerset In France it was observed at Cherbourg, near Lille, and at Calais and Dunkirk, in Belgium, at Brussels and Ostend, in Holland, at the Hague, Haarlem, and Amsterdam, and in the south of Norway Thus, the disturbed area can scarcely have been less than 760 miles long from north to south and 480 miles wide, or have contained less than 280,000 sq miles, that is, more than twice as much as that of any known British earthquake

IT was a happy thought that the rectorial address of Sir Arthur Keith to the students of Aberdeen, delivered on June 6, should have been associated with the celebrations connected with the 500th anniversary of the birth of Bishop Elphinstone, the founder of the University Sir Arthur took as the subject of his discourse "The Place of Prejudice in Modern Civilisation" He illustrated the significance of the opposing and yet overlapping mental characteristics generally spoken of as 'mind' and 'heart', the latter resident in the basal centres of the brain, the appetites and desires, the zest for life, unreasoned likes and dislikes—in a word, our prejudices These prejudices, local and national, are traceable to the prehistoric world, where the tribal sense was Nature's way of ensuring an isolation in which new traits could be developed They are an integral part of human nature the strength of nations which have not permitted the heart to overrule the head To ignore these prejudices is impossible, to root them out is to sacrifice a natural birthright So the universal brotherhood of man is seen to be as impossible of attainment, and even as undesirable, as the Determinism which, given a free hand, would make Europe again a vast conglomeration of warring tribal states Both reason and prejudice must be allowed a place in national policy, but the place of prejudice in modern civilisation should be that of servant, not of master

DR WHIPPLE of Kew Observatory, was among those Londoners who saw a great arc of light in the north eastern sky late on the evening of June 4, and he has kindly furnished some notes on the phenomenon as seen from Chiswick The curvature of the arc was very slight, but was unmistakable when it was viewed against a straight edge Its general appearance was like that of a rainbow, but without the colours of the ordinary rainbow Had the sun or moon been present in the sky the phenomenon would at first have been regarded as one of the many forms of solar or lunar halo, but its movement during the time that Dr Whipple observed it was sufficient to show that this was no halo At 10 30 P M (21 h 30 m G M T) it reached above the star Vega, but by 10 43 P M was 11° below that star at its highest point At 10 56 P M it passed through alpha Cygni at 11 4 P M just before low clouds hid it from view, 9° lower The breadth of the arc was about 2°, that is to say, about four times the diameter of the sun or moon

ACCORDING to information published in the *Daily Weather Report* of the Meteorological Office, Air Ministry, there was some cirrus cloud earlier in the evening moving from about south west Measurements of upper air temperature made at South Farnborough showed that conditions aloft were warmer than is normally the case even two months later, when the troposphere is generally at its warmest This warmth might have been expected, from the fact that a deep depression had been nearly stationary to the south west of Ireland for several days, causing northward movement of tropical air in front of it The progressive retreat of the arc towards the north-east horizon is consistent with the idea that the arc may have been some abnormal development of the cirrus clouds which were drifting in that direction Such a cloud might mark the boundary of air currents of different origin probably in the circumstances, both drawn from lower latitudes If anyone is able to furnish an account of observations similar to those made by Dr Whipple but at some distance from London, it might be possible to determine the height of the arc, which would probably be from four to six miles, if it was formed of cirrus cloud

PRESIDENT KARL T COMPTON of the Massachusetts Institute of Technology has been awarded the Rumford Medal of the American Academy of Arts and Sciences The award is made in recognition of Dr Compton's contributions in the field of thermionics, the study of electron emission from hot filaments and cathodes, and in spectroscopics, the study of matter by means of light waves Formal presentation of the medal will be made at the meeting of the Academy next autumn Dr Compton is the thirty sixth

recipient of the Rumford Medal, his brother, Dr Arthur H Compton, was awarded the medal in 1927 The Rumford Fund of the American Academy of Arts and Sciences was established in 1796 by Benjamin Thompson, the great physicist, who was a native of Massachusetts, and later became Count Rumford of Bavaria He was the founder of the Royal Institution The Rumford Medal is awarded to authors of the most important discoveries or useful improvements in light and heat, in any part of North America or in the American islands

IT is with pleasure that we offer our congratulations to Sir Oliver Lodge who attained his eightieth birth day on June 12 In doing so, we identify ourselves with the good wishes of the whole scientific world, since, during the last sixty years, Sir Oliver has not only built up for himself an international reputation for original conceptions and research in physical science but also as a brilliant expositor of scientific facts and principles His work has been recognised in a number of honours which have been conferred upon him by universities and other learned bodies In 1898, he was awarded the Rumford Medal of the Royal Society, in recognition of his researches on radiation and on the relations between matter and ether The discovery of electro magnetic radiation by Hertz was contemporaneous with the work carried out by Sir Oliver Lodge on the surging or oscillatory character of the transmission of electric discharges along wires He did much to make known in Great Britain the brilliant achievement of Hertz, and added much to our knowledge of the subject by his own investigations

FOLLOWING this epoch making work, Sir Oliver Lodge engaged himself with an investigation of the phenomena presented by Röntgen rays and the circumstances under which these rays are produced With these fundamental observations, he has carried on, for several decades, his contributions to our knowledge of radiations in ether, and also made suggestive speculations as to the properties of the ether itself The work of Sir Oliver on radiation, matter, and ether and its correlation with the works of such well known contemporary workers as Hertz, Michelson, and Morley is too familiar to call for any emphasis at present His researches into psychical phenomena began at a slightly more recent date The spiritual world which Sir Oliver considers to interact with the material, yet is not of it, has claimed his attention for a considerable time His stimulating address before the British Association in the Manchester College Chapel at Oxford in 1926 emphasised the necessity for a more scientific examination of these 'phantom walls' between the two worlds His exposition of his own views on efforts to find a place for life and mind beyond the world of physics, his fair discussions of the views of others, and his attractive methods for presenting his material, both in writing and in speech, have succeeded in giving him an exclusive place in the scientific world

THE Royal Research Ship *Discovery II* reached London on June 5, after a commission in the South Atlantic and Antarctic which lasted about eighteen months The scientific work accomplished includes extensive observations on the biological and hydrological conditions in the southern whaling areas and generally in the South Atlantic In each of the two seasons spent in the south, an intensive survey has been made of the South Georgia grounds, with other observations covering the whole of the Dependencies of the Falkland Islands, and the value of the results has been enhanced by the fact that these two seasons have differed very widely in respect of ice conditions Sectional lines providing very full data on both plankton and hydrology have been run between the Cape of Good Hope and the ice edge, and from the South Sandwich Islands to lat 15° N, while the ice-edge, a favourite resort of the whalers, has been examined almost continuously from Bouvet Island in the east to lat 101° W, a distance of about 2600 miles The *Discovery II* has also carried out coastal surveys of the South Sandwich Islands, Bouvet Islands, and parts of the South Shetland Islands and South Georgia Good results have been obtained with the Admiralty pattern of echo sounding apparatus, with which many thousands of deep water soundings have been taken The work is controlled by the *Discovery* Committee, appointed by the Secretary of State for the Colonies It has been carried out under the direction of Dr S Kemp, with Comm W M Carey R N (retd), in executive command

BY television is meant the transmission to a distant station by electrical means of moving scenes, which are viewed at the station practically simultaneously with their original occurrence Although it has been talked about for nearly fifty years, it is only six years ago since Mr J L Baird proved that it was practical Since then rapid progress has been made notwithstanding the great difficulties that had to be overcome Quite recently, screens have been shown in the theatre, and the audience has seen and heard people at a great distance away addressing them From the commercial point of view a great step will be made in advance if people can see sporting events – races, football, cricket and tennis matches, ceremonial processions, etc —on the apparatus in their own rooms and hear also an expert announcer describing them We learn from the *Times* of June 4 that the Baird Television Company, in co operation with the B B C, broadcast a television transmission of scenes from the Derby It included the parade of horses before the start and the scene at the winning post during the race This is the first attempt in Great Britain or any other country to secure a television transmission of a topical event held in the open air, where artificial lighting is impossible The engineers considered that the transmission was a success, and, more important still, they considered that it was quite possible that the outstanding interference difficulty with other transmissions could be overcome As the art of television has had to overcome many difficulties, including the apathy of electricians, we are glad that real progress is at last being made

JAMES CLERK MAXWELL was born on June 13, 1813. The celebrations of his centenary are to be held in

Cambridge on Oct 1 and 2 of this year, following the Faraday celebration and the centenary meeting of the British Association in London Delegates have now been nominated by the principal academies of the world and by the home universities, it is expected that about one hundred and fifty delegates will be present The celebrations will open with a ceremony in the Senate House, when the delegates will be welcomed and a memorial lecture delivered by the Master of Trinity Receptions will be given later at Peterhouse and St John's College On Oct 2 addresses will be given by Prof M Planck, Sir Joseph Larmor, and Prof P Langevin There will be a luncheon in Corpus Christi College, and, in the afternoon, addresses by Sir James Jeans and by contemporaries of Maxwell and a display of Maxwell apparatus and manuscripts in the Cavendish Laboratory The celebrations will conclude with a banquet in Trinity College Hospitality for delegates and guests of the University is being provided by the Colleges The University Press will publish a Maxwell Commemoration Volume, containing the addresses given at the celebration, with a contribution from Prof Einstein The Dean and Chapter of Westminster Abbey have given permission for a memorial tablet to Maxwell to be placed in the Abbey It is hoped that a tablet to Faraday will be placed at the same time, and that the two will lie together by Newton's tomb

THE issue by the British Association of a catalogue of the objects in the Memorial Rooms of Down House, Darwin's home at Farnborough, where he lived and worked for almost forty years, will be widely appreciated in view of the approaching centenary meeting of the Association in London Doubtless many of those who attend the meeting, especially from oversea, will be glad to avail themselves of the opportunity to visit this interesting and impressive memorial of "one of the greatest men of all time" Mr Buxton Browne, the curator and generous donor of Down House to the British Association, "to be held in custody for the nation", has restored the Memorial Rooms as nearly as possible to the state in which they were when Darwin lived there Much of the furniture is original, and, thanks to the generous assistance of members of the Darwin family and admirers of Darwin, the pictures and other objects and the articles which Darwin had in daily use are here in what was formerly their accustomed place Among the latest acquisitions are selections from the letters (in facsimile) from Darwin to Fritz Muller, the German naturalist, who was Darwin's correspondent in Brazil between 1865 and 1882 These letters were acquired in 1929 by Prof H Fairfield Osborn, of the American Museum of Natural History, New York. Prof A C Seward, professor of botany in the University of Cambridge, has recently expressed his intention of placing on loan at Down House the major part of the Darwin Library, which was bequeathed by Sir Francis Darwin to the professor of botany in the University for the time being The catalogue, which has been prepared by Mr Buxton Browne and the secretary of the British Association, gives brief historical and descriptive notes on the house and grounds, and is illustrated Its price is sixpence

THE subject for the Friday evening discourse at the Royal Institution on June 5, by Prof E W MacBride, was "Habit—the Driving Force in Evolution" Prof MacBride stated that evolution means the gradual growth of one species of animal into another All the available evidence shows that it has been an exceedingly slow process, and our knowledge of its actual course must be based on indirect evidence, for the amount of evolution observable during the span of a human life is infinitesimal There are only three reliable guides to evolution, namely (a) the relation to one another of local races within the species (b) so called lineage series of fossils where change in the same animal is observed as we ascend through a series of beds in the same locality, (c) the life histories of individuals All three classes of evidence when analysed yield the same result, that the individual steps in evolution are correlated with and caused by changes of habit the life history of the individual in its original form is seen to consist of superposed memories of a series of different habits That animals forced to live under different conditions and to accept different food from that to which they are accustomed acquire new habits and that these habits once formed are in some measure passed on to their descendants, has been proved by the experiments of Duckham on the white butterfly, by those of Heslop Harrison on the gall fly, and by those of Nuttall on the louse When by constant repetition a habit becomes deeply engrained in the hereditary constitution, the structure becomes permanently modified, because all structure is due to growth and habit affects growth It is suggested that as new habits imply the reaction not of a single organ but of the animal as a whole to a new situation, this reaction causes the deposit of some substance in all the nuclei of the body, including the nuclei of the germ cells When the germ cell nuclei become active from the new animal, this deposit is emitted at the proper period of development and affects growth and, through growth, structure

IN connexion with the International Colonial Exhibition which is being held this year in Paris and was recently opened by the President of the Republic, a Congrès International du Bois et de la Sylviculture is to be held on July 1–5 During this period there will be a day's excursion to Havre, and various receptions and so forth On July 6, a seven days' excursion will be begun, to visit some of the finest alpine forests in Savoie, Dauphiné, and Provence The work in Paris will be undertaken in morning and afternoon sessions of the several groups into which the Congress will be divided The aim of the Congress is to collect together all those who are in any way, either as owners, forest workers (State forest officers and others similarly employed), or commercial individuals, interested in the management of forests or in utilising forest produce, at one or other of the sections it will be possible to study economic, technical, industrial, and commercial questions which affect

forest management, as also international conventions which may assist in the better distribution of forest produce, in standardisation, and so forth The Congress will consist of French and foreign members and associate members Members may submit papers to be read and discussed at the Congress The French language will be the only one used at the sessions, and reports will be published in that language only The Congress is organised by the Touring Club de France, under the auspices of the Directors General of Forests and Technical Education, l'Institut des Recherches Agronomiques, le Comité national des Bois Coloniaux, and the Timber Group of la Confédération Générale de la Production Française All communications on the subject of the Congress should be addressed to Conservateur des Eaux et Forets, Secrétaire Général du Comité Exécutif, Touring Club de France, 65 Avenue de la Grande Armée, Paris (16e)

A COMMUNICATION from the U S Bureau of Standards, which appeared in the *Journal* of the Franklin Institute for May, on the liquefaction of helium, is of general interest On April 3 helium was liquefied in the Bureau's laboratory at a temperature of $-271\cdot2^{\circ}$ C, and this temperature was maintained for two hours It is only $1\cdot9^{\circ}$ C above the absolute zero It will be recalled that the late Prof H Kamerlingh after liquefying helium, reached a temperature of $0\cdot9^{\circ}$ A (NATURE, Mar 6, 1926, p 350) Helium has been liquefied previously in the Universities of Leyden, Toronto, and Berlin It has also been liquefied at the Reichsanstalt The temperature of liquid helium at atmospheric pressure is -269° C, but it was cooled further by reducing the pressure of the helium vapours over the boiling liquid by means of a vacuum pump The liquefier used is very similar to that designed by Dr M Ruhemann, of Berlin The helium is first purified and placed in a metal container and surrounded with liquid air at -190° C The helium, after being cooled by liquid hydrogen to -253° C, expands through a valve from a high pressure to a low pressure The amount of refrigeration is so small that the success of the apparatus depends on obtaining almost perfect thermal insulation The vapour pressure of the helium was determined, and hence its temperature was computed by a formula As further evidence, lead and tin electrical resistances were placed in the helium When the helium was liquid, both the metals lost their resistivity and became supra conducting It is interesting to remember that although tin, lead, mercury, and a number of other metallic elements and alloys become perfect conductors at these low temperatures, metals like gold, silver, and copper, which at ordinary temperatures are the best conductors, do not become supra conducting Many of the metals which at ordinary temperatures are poor conductors of electricity, at liquid helium temperatures become almost infinitely better conductors than gold, silver, and copper

THE liberation of eighty eight specimens of the Mandarin duck (*Aex galericulata*) on various London waters last year is worthy of note, as the bird is not only one of the most remarkable of wild fowl, but one of what may be called the world's most sensational birds, and the specimens in question were only wing-clipped, not pinioned, so that they have long ago, having moulted, regained the power of flight It is only in the case of wild fowl thus treated that the history of such birds can be really studied, for they are so much persecuted everywhere that on park waters alone can they be readily observed in most cases, while pinioned birds must always be inferior in some respect to intact specimens That they are often constitutionally impaired is shown by the fact that the Mandarin drake often fails to grow the characteristic and unique fan feather in the mutilated wing, while, as the species perches freely and nests in holes in trees, it cannot carry out its natural activities when deprived of flight Full winged birds have been living and breeding for years past on several private estates, and the species is probably now established as a British bird although seldom noticed, its semi nocturnal habits, and the fact that the showy male exhibits none of its decorations when in flight, would cause it readily to be overlooked—even pinioned birds in an enclosure cannot always be seen when looked for, if there be any cover available Up to Christmas of last year, a sufficient number had been seen to account for about half the total liberated, all had been ringed, and at least one has been reported this year as shot in Hungary, but most will no doubt settle down and breed in England somewhere or other

THE Zoological Gardens at Regent's Park are just now rich in ancestral and unique types of animal life Of particular interest is the exhibition of all the genera of dipnoan fishes, *Lepidosiren*, *Protopterus*, and *Neoceratodus*, and of the two aglossal anuran amphibians, *Dactylethra* and *Pipa* Among the mammals are to be noted especially the Anoa or pigmy antelope buffalo of Celebes, which looks much more like a large bush buck than an ox but, curiously enough, exhales in its breath the characteristic sweet odour of cattle This interesting species bred last year, and the calf is still to be seen, the pigmy hippopotamus has also bred recently The new bird house holds a particularly fine series of the family of barbets, little known birds which so perfectly connect woodpeckers and toucans that they are no doubt ancestral to both Of nearly a dozen species on view, the Asiatic *Megalæma virens* and its subspecies *marshallorum* strikingly recall in size of body and beak the smallest billed toucan, *Selenidera maculirostris*, *Chotorhea mystacophanes*, also Oriental, has a bill very like a woodpecker's, while the Abyssinian *Trachyphonus margaritatus* is so exceedingly unspecialised that it looks more like a small jay than anything else, and might well represent the ancestor of the triple woodpecker barbet toucan alliance Even more interesting is the Australian semipalmated goose *Anseranas*, which would have been better named *Anseribis*, for its feet, bare above the heel joint, scarcely half webbed, and provided with a long low placed hind toe, are those of an ibis, not of a goose, moreover, its plumage is not waterproof, it does not moult all its quills at once like other *Anatidæ*, and, as the specimens in the Waders Aviary in the Gardens show, is more ready to wade

than to swim It forms a most interesting contrast with the very specialised terrestrial goose *Cereopsis*, also Australian, and to be seen close by, along with our familiar grey lag

OUR notice regarding the law relating to treasure-trove (NATURE, April 25, p 647) has led a Scottish correspondent to point out that treasure found in Scotland must be offered, not to the British Museum, but through the agency of the King's and Lord Treasurer's Remembrancer to the National Museum of Antiquities in Edinburgh That is, indeed, so Our main object, however, in publishing the notice, was to keep the proper balance between finders, who are often scientific excavators, and the museums So far as we know, the law defining treasure trove is the same for Scotland as for England that is to say, treasure trove can consist only of objects of gold or silver, so that any attempt on the part of museum authorities to compel, by threat, the ceding of other sorts of objects, on the pretence that they are treasure-trove, would appear to be quite unjustifiable

ON more than one occasion we have commented upon the possibility of damage to agriculture which may be caused by the escape and spread of imported musk-rats in Great Britain We note with interest, therefore, that the Ministry of Agriculture and Fisheries has issued a notice requesting that any persons now keeping and breeding musk rats in England and Wales—whether for stock or pelts—would communicate at once with the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S W 1, stating the number of musk rats kept Since the chief interest of the Ministry must be the protection of the farmer, it may seem a little disingenuous to request from the musk rat breeders the evidence which may be used against them, under the plea that the Ministry is "anxious to obtain as full information as possible on the extent to which the musk rat (or musquash) farming industry is established in England and Wales"

THE Association of British Zoologists discussed at its general meeting the question of the payment of fees to zoologists for expert advice It is well known, as Prof E B Poulton says in a letter to us on behalf of the Council of the Association, that a somewhat unscrupulous public takes for granted the good nature [and affluence !] of zoologists in requesting their professional help without offering payment in return Whether it be a matter of the identification of a species or the delivering of a popular lecture, both demand the expenditure of time and energy, which the expert could have devoted profitably to his own purposes The Council's proposal is that, in the interests of their science, zoologists should demand fees for the work of identifying specimens and giving lectures They say that such a demand would enhance the respect felt for the science, just as medical advice tends to be valued according to the size of the fee We are not quite sure of this, there is a great difference between the urge of the man going to the best physician to have his own health established, and that of the man inquiring about an unknown insect Insistence upon fees, at least in trivial cases, such as the annually reiterated identification of *Sirex gigas*, would simply drive the sender to drop the subject, and a promising helper might thus be lost In the case of technical advice accompanied by identifications and in the case of lectures to outside bodies, fees might well be insisted upon Since the difficulty largely arises from the unwillingness of zoologists to be looked upon as mercenary, the Association would be making things easier for individuals if it were to print slips bearing a standard rate or rates of fees for advice and lectures, an impersonal hint which might be included with replies to importuners

SUGGESTIONS have recently been put forward that, so far as can be seen from photographs of the airship *R101* wreckage, certain of the lower members were crumpled as if by a compressive load, and that the cause of this was excessive bending due to the tail load arising from the maximum up position of the elevator From this it is inferred that elevators at the bows would be preferable This comment is unjustified, in that the findings of the Court were that the methods of stressing the structure were fundamentally correct, and that their application to this particular design had been amply confirmed by tests upon experimental sections, built especially for test purposes It is impossible to conceive that the possibility of having to use the maximum control moment had not been foreseen by the designers, and also the independent airworthiness panel Conditions producing compression in the lower members might easily have arisen at the instant of striking the ground at a shallow downward angle The forward movement of the nose would be arrested while the momentum would carry the tail end onwards The principal objection to placing the elevators in the bows is that the disturbance of the air flow along the body would increase the resistance and interfere with the stability The effects of either of these might easily be so great as to make the ship a practicable impossibility

REFERENCE was made in NATURE of May 9, p 717, to the issue of the *Power and Fuel Bulletin* by the British National Committee of the World Power Conference Further issues of the *Bulletin* have since been received, and the publication of these abstracts directs attention to an important question, namely, the rationalisation of abstracting Too many organisations are engaged in the abstracting of narrow fields of scientific and technical literature The constituent bodies responsible for this *Bulletin* in pooling resources have set an example which should receive consideration by others Whether the present production will satisfy everyone is, however, open to question The documentation by nations has certain advantages, but in this *Bulletin* it leads to the inclusion of material published in trade papers as scarcely veiled advertising matter This applies particularly to engineering plant, and the mere mention of such papers is doubtless sufficient The *Bulletin* is mainly concerned with engineering literature, and those responsible seem at times to deal with original research in the same manner Divergent views may be held as to what constitutes an abstract Should it be merely a table of contents, or should it be an attempt to give an idea

as to what the author claims to have done clearly and briefly, stripped of every superfluous word? In this *Bulletin* the first view seems to find favour, with results not always satisfactory

IT is announced in *Science* that Sir James Jeans has been given the honorary degree of doctor of laws by the Johns Hopkins University, Baltimore

THE Albert Medal of the Royal Society of Arts for 1931 has been awarded by the Council to H R H the Duke of Connaught, K G, "in grateful appreciation of his Presidency of the Society since 1911"

PROF H LEBESGUE, professor of mathematics at the Collège de France, and Prof A F Molengraaf, professor of geology at Delft, have been elected associates of the Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique

IN April last, Mr C W A Scott set up a new record for the journey by air from England to Australia It will be remembered that he took just over nine days for the flight (NATURE, April 18, p 604), thus beating Air Commodore Kingsford Smith's time by nearly a day He has now flown from Australia to England in eleven days, again beating a record set up by Air Commodore Kingsford Smith Mr Scott started from Wyndham, in the Northern Territories, early on May 26, and arrived at Lympne aerodrome on the evening of June 5, his time being given as ten days twenty three hours for the journey The last stage of the flight was from Brindisi to England, which he accomplished without a stop in very stormy conditions The machine he used was a small Gipsy Moth placed at his disposal by Lord Wakefield, it is an older pattern than the machine he used on his outward flight

TWO interesting and successful receptions were held at the National Institute of Industrial Psychology on June 1 and 2 Guests were received by the president, Lord D Abernon, Mr H J Welch, Lady Ruth Balfour, Dr Myers, and Dr Miles, and on each occasion about 350 guests witnessed a series of fourteen brief demonstrations, as well as films, illustrating the applications of psychology which have been made in different industries, and the methods by which psychologists are giving aid in the selection of workers The broad appeal which this very young applied science makes is evidenced by the distinction and variety of the guests Those responsible are to be congratulated, not only on drawing such large numbers, but also on the skill with which the guests were both instructed and interested for nearly two and a half hours The demonstrations included methods and results of industrial investigations, assembly operations, measurement of ventilation and lighting conditions, influence of rhythm on motor activity, a test for motor driving, selection tests, tests of perseveration, colour discrimination, movement study, vocational guidance, and psychogalvanic reflex These demonstrations well illustrated the very practical work which is being carried on by the Institute, both in industry and for private individuals, under the supervision of the director, Dr Miles, and the researches conducted under the direction of the principal, Dr Myers

A VOLUME of "Sydney University Reprints" (Medical Sciences, non-clinical) has recently been issued (series 9, vol 2, Nos 13 38, 1930) It includes two papers by W Bishop on the occurrence of lead in the egg of the domestic hen, papers on micro-methods of chemical analysis and estimation of chlorides in tissue by W R Mankin, and a titration method for the determination of potassium in urine by A Bolliger and E M Day, all of which should prove of service in the clinical pathological laboratory

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A research student at the Institute of Pathology and Research, St Mary's Hospital—The Secretary, Institute of Pathology and Research, St Mary's Hospital, Paddington, W 2 (June 16) A lecturer in agricultural botany at the Royal Agricultural College, Cirencester—The Principal, Royal Agricultural College, Cirencester (June 17) An assistant lecturer in geography at the University College of the South West of England—The Registrar, University College, Exeter (June 18) Three probationary forest officers under the Forestry Commission—The Secretary, Forestry Commission, 9 Savile Row, W 1 (June 18) A civil or mechanical engineer under the Safety in Mines Research Board, in connexion with the development of research into haulage problems in mines—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S W 1 (June 20) An assistant pathologist at the South Devon and East Cornwall Hospital, Plymouth—The General Superintendent and Secretary, South Devon and East Cornwall Hospital, Plymouth (June 20) A full time graduate assistant in the Department of Engineering of the Leicester College of Technology—The Registrar, College of Technology, Leicester (June 23) An assistant lecturer in zoology and two research biologists, the latter with special experience with plankton work, at the University College of Hull—The Registrar, University College, Hull (June 23) A junior assistant at the Ditton Research Laboratory, East Malling, Kent, for work on the preservation of fruit—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (June 27) A registrar of Armstrong College—The Registrar, Armstrong College, Newcastle upon Tyne (June 30) Junior assistants in the Physics and Aeronautics departments of the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (June 30) A professor of mathematics and an assistant lecturer in physics at University College, Southampton—The Registrar, University College, Southampton (July 6) A William Hudson professor of economics at Natal University College—Webster, Steel and Co, 9 St Helen's Place, Bishopsgate, E C 3 (July 15) A geography tutor at the Chester Diocesan Training College—Rev Canon Thomas, Diocesan Training College, Chester An assistant master to teach mechanics and metal work in the senior school of Sawston (Cambridgeshire) Village College—The Education Secretary, County Hall, Cambridge

Research Items

Nose-piercing as a Puberty Ceremony—Among the Kamia, an Indian tribe of Imperial Valley, south-eastern California, nose piercing is practised as the essential feature of the boys' puberty ceremony According to information obtained by Mr E W Gifford and recorded in *Bull 97* of the American Bureau of Ethnology, no youth can marry until he had undergone this operation The usual age for marriage was about fifteen years Not less than four boys can be operated on at one time, and if the number ready for the ceremony is insufficient it has to be postponed The chief takes the initiative, but the parents' consent has to be obtained Large quantities of food are necessary, of which the greater part is supplied by the chief and the rest by the parents The chief's 'policeman' removes the boys to the bush during the latter part of the night, and remains with them until they return to their homes The operation is performed by four operators, who use needles of screw bean wood Immediately after the operation the 'policemen' force the boys to run six or seven miles to a house and back They are then kept at the place of operation for four days, and are allowed to eat only watermelon and corn mush Each morning the 'policeman' washes their noses with hot water, and day and night men and women sing continuously near the place of confinement When on the morning after the fourth night they go home, they remain naked for a month and eat no fish, deer or jack rabbit The hole in the septum is kept open by a piece of arrow-weed stick Later, strings of white clamshell beads are worn hanging from the septum Sometimes these are long enough to hang in front of the lips and have to be lifted when the man wishes to eat

Food of the Sea Trout—Our knowledge of the food of the sea trout has been drawn only from isolated observations from widely scattered localities It is necessary therefore that a more intensive survey should be made of the food of these fish, both as regards the time of the year and its composition in different habitats A preliminary investigation with this end in view has been made by Dr C H O'Donoghue and Miss E M Boyd (*Fisheries, Scotland, Salmon Fish*, 1930, No 3) A start has been made by the examination of the stomachs of a number of sea trout from two localities, nineteen fish having been examined in May and June from Spey Bay, a purely marine habitat, and 144 at fortnightly intervals from the beginning of May to early September from the tidal limits of the River Forth near Stirling, typical of an estuarine habitat It was found that while all the fish from Spey Bay were feeding, the majority of those from Stirling had empty stomachs, those from the marine environment had been feeding chiefly on the sand eel (*Ammodytes lanceolatus*) or on the young metamorphosing stages of the herring The fish from Stirling, the stomachs of which contained food, had, however, been feeding more on crustaceans such as gammarids and mysids, and also on ephemerid nymphs, these estuarine fish also do not contain nearly so much food as do those from Spey Bay It is clear that continuous and intensive observations of this kind are needed to help to understand the large differences in rate of growth noticed in fish from different localities.

Anopheline Mosquitos in Southern Rhodesia—Southern Rhodesia, with an area of about 150,000 square miles, is a vast country for purposes of conducting an *Anopheles* survey. No 4 of the Memoir Series of the London School of Hygiene and Tropical Medicine (March 1931) is a report by Mr H S Leeson on observations carried out on these insects during the years 1926–1928 It deals first with the anopheline mosquitos of the country in a general way, and secondly, with those of a particular area where blackwater fever is endemic By diligently collecting mosquitos ever a wide area, it appeared likely that it may be possible to distinguish between those species prevalent in the zone of high blackwater fever incidence and those found elsewhere Special attention was paid to collecting in the neighbourhood of Shamva and Salisbury—the former being in a so called blackwater fever area, and Salisbury in a region now entirely free from that disease Five species of *Anopheles* made up 97 per cent of the total number of adults collected *A funestus* and *A gambiæ* occurred in largest numbers in the Shamva area, and when the incidence of malaria was at its highest When the number of malaria cases was lowest, *A funestus* was in hibernation and *A gambiæ* was entirely absent In the Salisbury area these two anophelines were extremely uncommon The freedom of Salisbury from blackwater fever is due largely to improved conditions of sanitation In order to reduce the number of anophelines in Shamva it is essential to create an environment unsuited to these insects The report concludes with a series of measures recommended to be carried out towards achieving this end

Crustacea of the Vanderbilt Museum—Miss Lee Boone describes a large number of Crustacea in the third volume of the "Scientific Results of the Cruises of the Yachts *Eagle* and *Ara*, 1921–1928, William K Vanderbilt, Commanding" (*Bulletin* of the Vanderbilt Museum Volume 3 Crustacea Anomura, Macrura, Schizopoda, Isopoda, Amphipoda, Mysidacea, Cirripedia and Copepoda, 1930) The previous volume (vol 2) dealt with the crabs This part is on the same plan and is a handsome book, well printed and with excellent illustrations, both photographic and in line The line drawings by Mrs Helen Ziska are to be commended specially The specimens consist chiefly of the Anomura and Macrura, although there are a few schizopods, isopods, and amphipods, usually represented by one or two species in each group, one cirripede, and three copepods, two of which are parasitic Notes made when the specimens were collected are, as before, a feature of the descriptions, and the information as to colour and habits, besides much that is new in the way of distribution, makes the work a valuable addition to our knowledge of the Crustacea Many of the species described are widely distributed, but some are very rare and so far only known from the type specimens Amongst the more interesting finds are a new species of *Porcellana*, *P rosamundæ*, from Simon Bay, Panama, two specimens of the interesting little abyssal hermit crab *Parapagurus pilosimanus abyssum* from 1100 fathoms, off Miami, Florida, and seven specimens of *Caligus aliuncus*, the male of which is recorded for the first time, from the skin of a dolphin

Drought Resistance in Plants—An important physico chemical study of the nature of drought resistance in Canadian crop plants is presented by R Newton and W M Martin in the *Canadian Journal of Research*, 3, 336-427, 1930 Ratio of water loss by evaporation under controlled humidity conditions, in the case of cactus segments and detached grass leaves, showed the remarkable ability of the cactus to retain moisture, but showed no relation to the relative

drought resistance of the grasses The osmotic pressures of the tissue fluids did not prove a reliable index to the capacity of the tissues to resist droughts, but bound water' content proved much more dependable This property was usually determined by the lowering of the freezing point resulting from the addition of known quantities of cane sugar to the expressed juice In proportion to the extent that water was bound by the plant colloids present the concentration of the cane sugar was greater than it should be as calculated from the total water content present, and the lowering of the freezing point accordingly increased In view of the considerable difficulty at present in the way of the interpretation of this concept of bound water the elucidation of these experimental results may have to wait but these physico chemical studies supply much necessary data for the further understanding of the complex factors involved in the plant s resistance to drought

Silver Leaf Disease of Plums —The sixth part of a very intensive study of silver leaf disease of plums by F T Brooks and his associates has just appeared (*Jour of Pomol and Hort Science* vol 9 No 1 Silver leaf Disease—VI by F T Brooks and G H Brenchley pp 1 29 March 1931) It is good to note that these workers have begun experiments on the incidence of disease on trees worked on different stocks though no definite results are as yet available The appearance of the so called gum barrier below wounds has been investigated and its role in impeding the spread of the fungus is discussed in the paper The protection of pruning wounds by soft grafting wax or home made white lead paint is again emphasised Manurial treatment of the host seems to have no direct effect on the incidence of the disease but vigorously growing plum trees are more likely to recover from the malady than those of weaker growth The danger of cutting back stock shoots in the process of propagation is shown and it is suggested that such wounds be protected by means of soft grafting wax The present paper raises many problems for future investigation especially those concerning the formation of the gum barrier of a tree which recovers from an attack of the fungus

Virus Diseases and Associated Protomyxean Organisms – Several workers on virus diseases of plants have reported that various primitive organisms are often found in the tissues of the hosts attacked Iwanowski so long ago as 1900 noted the association of bacteria with virus infected cells but could find no causal relation between the former and the disease A very detailed piece of work by Miss Ethel I McLennan has just been published in the *Australian Journal of Experimental Biology and Medical Science* vol 8 pt 1, March 1931, pp 9 44 and adds yet another such example to our knowledge A disease of hops which is very prevalent in Tasmania is described, and is adjudged to be in all probability a virus disease on account of the similarity of its symptoms to those described in England by Salmon and Ware, and sometimes called false nettle head The relation of the new disease to true nettle head is discussed, and the two are thought to be quite distinct from each other, since no eelworms are associated with the Tasmanian malady The protomyxean organism which has been isolated and cultured is *Leptomyxa reticulata* Goodey, var *humuli* nov var It is normally a soil organism and is associated with some of the virus infected plants The parasite has been found to enter the host through the cells of the epidermis or through root hairs, and it is thought that the virus disease lowers the resistance of the plant to such parasites No attempt to find a causal relation between the parasite and the virus disease has been made

New Guinea Tobacco – Dr A C Haddon s interest in the cultivation and introduction of economic crops and their bearing on the development of the people concerned is well known Anthropology Report No 11 published by the Government Printer Territory of Papua, entitled The Species of Tobacco grown in New Guinea is an example of this This investigation was initiated by Dr Haddon who in a preface states that he has long been interested in the decorated pipes of New Guinea and the distribution of the methods of smoking in the island A collection of the different kinds of tobacco found under cultivation in the island has been made and an examination of the material has been undertaken by Mr J S L Gilmour, of Clare College, Curator of the Herbarium, Botanical Museum Cambridge, who is the author of this report This examination involved the raising of many samples from seed So far as the material examined represents the types under cultivation it is shown that all of them are varieties of *Nicotiana tabacum* Linn and types of China Manila and Java tobacco are represented This confirms the opinion of Dr O Finsch (Samoafahrten , Leipzig, 1888 p 58) that this tobacco is *N tabacum*, but is contrary to the view expressed by J H Maiden in a paper contributed by him to the *Proc Linn Soc N S W*, 1888 on New Guinea tobacco which stated that East Indian Manila and Turkish tobaccos are the produce of *N rustica* Linn This statement of Maiden s was made although Mr Hugh Dixson a high authority on tobacco in New South Wales pronounced that the samples which were submitted to him by Maiden were the same species as the tobacco of commerce

Tidal Frequency of Earthquakes —The relation between tidal phases and the frequency of earthquakes is discussed in a recent paper by S Yamaguti (*Bull Earthq Res Inst* vol 8 pp 393 408, 1930) In earlier investigations on the subject the origins of the earthquakes considered were unknown Mr Yamaguti confines his study to the after shocks of the Kwanto earthquake of 1923 the Tango earthquake of 1927 etc in which the epicentres were distributed within well defined areas In all of these he finds that the frequency is greatest at or a little before, the time of low water at a neighbouring station while a secondary maximum appears before high water on the Kwanto curve and a little after high water on the other curves There is, however an interesting difference between the Tango after shocks that originated beneath the sea bed and on land on the northern side of the Yamada fault The former have two maxima $1\frac{1}{2}$ hours before and after high water the latter a principal maximum about low water and a secondary maximum about high water

Oceanographical Research North of Siberia —In the Norwegian magazine *Naturen* for January 1931 (vol 55) Dr H U Sverdrup, in his paper Resultater av Maudferdens Oceanografiske undersøkelser , describes the results of his oceanographical research in the seas north of Siberia the hydrographical stations being mainly in the region of the New Siberian Islands the East Siberian Sea, and, eastward, in the water between this and Alaska called the Chakotsk Sea The bulk of the work was done in the East Siberian Sea depth, currents and winds, salinity, oxygen content, and hydrogen ion concentration all being investigated There is much ice in these parts and samples were taken even when the vessel was ice bound Plankton samples were

taken to a small extent, the Chakotsk Sea having a good deal of phytoplankton in its surface waters. It is noted, however, that the phytoplankton, although it can live where the ice is, does not develop freely under ice bound conditions. The bulk of the work is on oceanographical hydrography, and there are clear maps showing the main regions with the stations and diagrams illustrating the various aspects of the researches which are interesting and valuable.

Diffraction of Very Fast Electrons.—An experiment is described by E. Rupp in the *Annalen der Physik* (vol. 9, No. 4) which verifies the de Broglie formula for the wave length of an electron—Planck's constant divided by the momentum—under conditions when the relativity correction to the mass is large. Using an interference apparatus similar to that of Prof. G. P. Thomson, with a gold scattering foil, the interference rings produced by electrons which had fallen through a potential difference of a little more than 200 kilovolts were obtained and measured. From the ring pattern the electron wave length was calculated to be $2.162 \pm 0.013 \times 10^{-10}$ cm., the lattice constants for gold crystals being taken from X-ray data; the corresponding quantity calculated from the de Broglie relation and the accelerating potential acting on the electrons was $2.183 \pm 0.035 \times 10^{-10}$ cm., showing that the relativistic formula for the change of mass with velocity is accurate in this region to at least one per cent.

Colours of Metallic Films.—Films of gold and silver have attracted a great deal of attention at various times on account of the colours which they impart to transmitted light, and have been studied by Faraday, Beilby, R. W. Wood, and others. An investigation of the effect of temperature on their optical properties is described by S. R. Swamy in the May number of the *Proceedings* of the Royal Society, and it has been shown that the electromagnetic theory of the phenomenon due to Garnett can be made to account for a great part of what is observed. Dr. Swamy makes the fundamental assumption that the effect of warming is to disintegrate a film, some parts turning dense at the expense of other parts which become thinner or vanish completely; the latter places act as effectively transparent windows, which transmit unchanged part of the incident light and so dilute the true absorption colour. This idea certainly receives support from the mottled appearance presented by the microphotograph of a heated gold film, but is perhaps inadequate to account for all of Prof. Wood's results.

Propagation of Magnetisation.—When the magnetisation of a ferromagnetic body alters with the specimen under the influence of a mechanical stress, the hysteresis loops contain abnormally large discontinuities. An investigation of this phenomenon, which is allied to the well established Barkhausen effect, is described by L. Tonks and K. J. Sixtus in the second April number of the *Physical Review*. It appears that the change in magnetisation starts at a nucleus. From this a magnetic wave travels away with a speed which is related in a simple manner to the field in which propagation occurs and varied from 500 to 40,000 cm. per sec. under the conditions studied. As the wave progresses, eddy currents are set up in the metal, and, by dissipating the energy available from the magnetic change, limit the velocity with which the change penetrates the specimen; the effect of changing the lateral dimensions of the piece of material indicates that the velocity depends primarily upon surface phenomena. A reasonable picture offered for what occurs is that the magnetic reversal takes place within a very small distance of an approximately conical surface—in a wire—the edge of the base of the cone being the front of the wave. In addition to depending upon the magnitude and nature of the stress, the effect changes with the composition of the material, but so far no new relation to other properties has been ascertained.

Electrical Discharges in Gases.—The April number of *Reviews of Modern Physics* contains a second article on electrical discharges in gases by I. Langmuir and K. T. Compton. The first article, which appeared earlier in the same journal, gave a summary of those properties of atoms and electrons, considered as individuals, which are important in conduction. The present paper deals with the collective behaviour of the particles under relatively simple conditions, and is largely an account of the electrostatics of charges which are distributed throughout spaces of definite shape. It thus differs from classical treatments of the subject in being not mainly concerned with charged surfaces only, but also to a large extent with rather general solutions of the Poisson equation. Practical knowledge of this nature is naturally of much value in the design of thermionic apparatus for the utilisation of high vacuum discharges, but is far from being confined to this, being fundamental both in the theory of the use of exploring electrodes for the analysis of various forms of gas discharge, and in the theory of the mechanism of the grid controlled arcs, or thyratrons, which are now finding many experimental and technical applications. The theory also differs considerably from classical electrostatics in its continual use of numerical data both with the view of practical applications and in consideration of the validity of approximations which are frequently useful or necessary; and, for similar reasons, it is usually desirable to express complicated results ultimately in series, rather than by the use of special functions. It is no exaggeration to say that these ideas which, although they are in a sense the logical outcome of the earlier work of Sir J. J. Thomson and of Prof. Townsend, have been carried to their present stage almost entirely by Dr. Langmuir and his collaborators at Schenectady, have revolutionised the outlook on the nature of electric discharges through gases, and seem likely to make it possible to analyse fairly completely the processes operative in any particular type.

Pipe Line Corrosion.—The extensive corrosion which has occurred on some sections of the pipe lines used by the oil companies of the United States has led to the co-operation of the companies and the Bureau of Standards in an investigation of its causes, and the results are given in the April issue of the *Journal of Research*. Nine pipe lines between the Gulf of Mexico and Kansas have been examined, and it has been found that every line has electric currents flowing along it, generated by differences in the states of the metal and of the soil where they come into contact. These currents are found to flow into the pipe from the soil where the soil has a high electrical resistivity, and out of the pipe into the soil where the soil has a low resistivity. The corrosion occurs where the electric current flows out of the pipe into the soil, that is at points where the resistivity of the soil is low, and at such places the pipes should be suitably coated. The Bureau has produced a simple apparatus for measuring soil resistivity, which consists of two sticks shod with iron cones connected by wires in the axes of the sticks through a milliammeter to two dry cells. The sticks, which are about the size of walking-sticks, are thrust into the ground about 20 centimetres apart, and the current read. From the current and the constant of the apparatus the resistivity of the soil is calculated.

The Royal Observatory, Greenwich

ANNUAL VISITATION

THE visitation of the Royal Observatory was held on Saturday afternoon, June 6 A large number of guests were present, and took part in the inspection of the instruments and other exhibits

The report of the Astronomer Royal to the Board of Visitors begins with the very welcome announcement that Mr William Johnston Yapp has made the generous donation of £15,000 for the purpose of providing a 36 inch reflector, with a spectroscope and a 34 foot dome This magnificent gift has been gratefully accepted by the Lords Commissioners of the Admiralty, and the order for the erection of the instrument will be placed with Messrs Sir Howard Grubb, Parsons and Co

Another satisfactory announcement is that the Lords Commissioners have sanctioned the purchase of a new transit circle the present one has been in use for eighty years the object glass has become so thin that it will not bear further repolishing, and many of the divisions on the circle are almost obliterated, attempts at recutting these have not proved permanent A model of the proposed new instrument was on view It will be, in general, similar to the reversible transit circle at the Cape and will be entrusted to Messrs Cooke Troughton and Simms, who made that instrument it will be somewhat smaller than the present instrument, an aperture of seven inches and a focal length of eight feet are proposed, also a motor driven micrometer for recording transits The roof will be in the form of two semi cylinders with axes running east and west, and sliding apart so as to give a wide central aperture The design is to give free circulation of air, and avoid abnormal refraction, with this aim the transit room will be put at some distance from other buildings It is recognised that the opening in the roof of the present instrument is too narrow and that the shutters, when open, impede the free circulation of air The collimators of the new instrument will be outside the main building

More than eleven thousand transits and circle readings were obtained with the transit circle during the year, the sun being observed on 131 days and the moon on 79 The report gives the errors of the sun in longitude since 1901, when Newcomb s tables were introduced, the error gradually rose from zero to 1 65″ in 1922 (observed greater than tabular), since then it has remained nearly stationary The errors of Brown's tables of the moon have steadily diminished from 7 1″ in 1922 (observed greater than tabular) to 5 2″ in 1930

The observations for the catalogue of 10,800 stars between N Decl 32° and 64° were completed last December The new catalogue will cover the regions 0° to 24°, and 64° to the pole The Astronomer Royal notes that this will probably be the last considerable undertaking with the present transit circle It is now considered unnecessary to observe stars fainter than magnitude 7 5 or 8 on the meridian, fainter stars are observed photographically on plates of large area, on the plan initiated by Prof Schlesinger

The 28 inch equatorial was used for observing 258 double stars, 52 of which were less than ½″ apart An electric motor has been installed for rotating the dome, this enables one observer to work the instrument without assistance The determination of stellar parallaxes with the 26 inch refractor has been continued, 1140 good plates were secured during the year, and 950 plates were measured, leading to the determination of 34 new parallaxes During November, December, and January 110 plates of Eros were obtained on 19 nights

With the 30 inch reflector the determination of the colour temperature of stars has been continued A Kodak standard acetylene burner (colour temperature 2360° K) is now used as standard instead of a carbon arc, a colour filter is inserted in the beam from the burner Each plate contains images of a high star, of two low stars for determination of atmospheric absorption, and of the burner The results indicate 13 000° to 14 000° for the temperature of a star of type Ao When the new 36 inch reflector is ready it will be used for this work As the 30 inch is on the same mounting as the 26 inch, observations of parallax and colour temperature cannot at present be made simultaneously

Photographs of the sun were obtained on 260 days, the record has been completed by plates from the Cape, Kodaikanal, and Tortosa Solar activity has diminished considerably, but large spots were seen in October, February, and March With the spectroheloscope considerable solar eruptions were observed on Aug 12 and Nov 25, the latter gave an outward velocity of 450 km /sec, which is near the parabolic value

The following are the mean magnetic elements obtained at Abinger in 1930 Decl 12° 24 6 W Hor force 0 18542, Vert force 0 42924, Dip 66° 38 2 The decl is diminishing at the rate of 11½ annually, so that it should vanish a little before the end of the century Magnetic observations are occasionally made at Greenwich in the early morning, when electric trains are not running, these will be continued, as there is an unexpectedly large range in the determinations of decl as compared with the Abinger ones

The following weather records refer to the year ended on April 30, 1931 temperature 50 0°, being 0 5° above the average, highest 92 2° on Aug 28 and 29, lowest 21 0° on Mar 10 There were 55 days when temperatures of 32 0° or lower were recorded, the mean daily movement of air was 289 miles, being 5 miles above the average, the greatest value was 713 miles on Jan 17 There were 1320 hours of bright sunshine or 29 6 per cent of the possible amount The rainfall was 27 94 inches, which is 3 70 inches above the average, on June 18, 2 66 inches fell in 2 hours

Time determinations are now made with a small reversible transit instrument fitted with a travelling micrometer, two Shortt clocks (No 3 and No 11) are used as standards of sidereal time, the progressive increase of losing rate of No 11 still continues The mean time signals are controlled by Shortt No 16 Wireless signals from Paris, Nauen, Annapolis, and Bordeaux are registered automatically, they all agree in being apparently late on Greenwich, the amounts being 0 016 sec, 0 044 sec, 0 039 sec, and 0 033 sec respectively The Annapolis one is corrected for time lag The difference is unquestionably systematic, for out of the 48 monthly means that are printed in the report there are only three that are earlier than Greenwich

Several photographs were exhibited of Eros and neighbouring stars, these were measured for three different purposes The principal research was the solar parallax and the mass of the moon, the second was the light variation, which was plainly visible in the series of images on some of the plates The third was the determination of mean wave length of Eros and the comparison stars, which was effected by placing a grating before the object-glass

A C D CROMMELIN

Messages in Sensory Nerve Fibres and their Interpretation *

BY amplifying the electric changes which take place in the individual nerve fibres it is possible to record the messages which pass from the sense organs to the central nervous system and from the motor nerve cells to the muscles It is found that a series of brief potential changes travel along each nerve fibre, the changes are of fixed intensity and duration, but their frequency varies with the intensity of the excitation Each potential change represents a nerve impulse of the type made familiar by the classical methods of electro-physiology Reasons are given for the belief that all nervous communication is carried out by such impulse messages, and that the impulses, like the electric changes which accompany them, are unaffected by variations in the intensity of the stimulus The general similarity of motor and sensory messages makes it probable that the sensory nerve endings and the synaptic regions of the central nervous system work on a common plan depending on the fundamental properties of excitable cells

The sensory messages which have been most thoroughly investigated are those produced by the muscle spindles Those from the skin receptors are less easy to analyse but are of greater interest to the physiology of sensation At present the most definite results have been obtained from the frog The frog's skin contains receptors which respond to light contact with a brief discharge of impulses travelling in nerve fibres which conduct rapidly A vibrating stimulus gives a series of impulses with the same frequency as that of the stimulus, but discharges of high frequency and long duration from these receptors do not give rise to pain Stimuli which would be likely to cause continued pain give rise to impulses of small action potential travelling in fibres which conduct very slowly (about 1 metre a second)

In the mammal, as in the frog, light touch produces a brief discharge of impulses of large potential conducted rapidly, and firm pressure gives a continued discharge Impulses of smaller potential conducted at slower rates are produced by movement of the skin and persistent discharges often arise from exposed tissues At present it appears that some of these impulses are caused by stimuli which would not necessarily be painful

A comparison of these results with those of Gasser and Erlanger and of Piéron shows that the nerve fibres responsible for pain are not all of the same type, though they are all of smaller diameter than the tactile fibres It is suggested that the rate of reaction and amount of convergence in the sensory pathways are important factors in determining the intensity of sensation, since this must depend on a summation of the effects of discontinuous impulses

* Abstract of the Croonian Lecture delivered before the Royal Society on June 4 by Prof E D Adrian F R S

Fisheries Research at Hull

THE Department of Zoology in the University College of Hull has recently been expanded into that of Zoology and Oceanography From its first establishment it has been intended that there should be co-operation between the Department of Zoology and the fishing industry The Humber ports form the largest fishing centre in the world The Council of the College has now decided to put into operation a scheme of fishery research which is to be organised by Prof A C Hardy A new section will be added to the accommodation of the department and three research biologists will be appointed The capital expenditure will be borne by the College, but the greater part of the maintenance charges will be met by a grant from H M Treasury, which has been made on the recommendation of the Development Commissioners A grant towards the cost has also been made by the Fishmongers' Company, and it is hoped that contributions will be made by the fishing industry itself The scheme of research, which will be carried out in co operation with the Ministry of Agriculture and Fisheries and the Fishery Board for Scotland, and will be co-ordinated with the researches of the International Council for the Exploration of the Sea, concerns the distribution of the North Sea plankton in relation to the movements of fish, particularly the herring

It is the policy of the department to carry out this research not from a single research ship, but from fishing vessels and other commercial ships which are prepared to carry specially designed self recording instruments for plankton and other measurements. It is believed that there are certain important problems connected with our knowledge of the sea and its changing conditions which cannot be solved by using one research ship to cruise over the area concerned, just as a knowledge of the weather cannot be obtained by having one meteorological station moving about from place to place It is proposed to chart in broad outline the monthly movements of the North Sea plankton by the simultaneous use of continuous plankton recorders on a number of scheduled steam ship routes across the North Sea, and to correlate the distribution of the plankton with the concentration of fish as reported by the industry The herring shoals do not always turn up where they are expected, they move their ground from time to time, usually the fishermen can find them, but sometimes they cannot, at any rate in sufficient numbers to make a successful season When, over a period of five years, a knowledge has been gained of the changing distribution of herring food and patches of such organisms as *Phæocystis* and *Rhizosolenia*, which the herring apparently avoid, it is hoped that it may be possible to make forecasts as to the position of the shoals of herring From this work a wider field of investigations should be opened up, including a study of the possible causes underlying the fluctuations in the stocks of different fish

A new continuous plankton recorder suitable for use on commercial ships has been designed, it is an improvement on and a smaller pattern than, the original machine which was first used on the 1925–27 *Discovery* Expedition and was described in NATURE of Oct 30, 1926 It is towed like a paravane behind a ship and continually samples the plankton in the water traversed The plankton is collected on a long banding of fine silk netting which winds into a preservation chamber It is worked from the water by a propeller, the adjustable blades of which allow each of a series of numbered divisions on the moving silk to represent a mile or more of sea The rolls obtained are kept for examination on a special microscope substage

A number of simpler instruments, obtaining a single sample of the plankton for correlation with the catch of herrings, will be used by herring drifters when engaged in fishing

In addition to the research programme, a one year course in oceanography with particular reference to fishery problems is being arranged for post graduate students

University and Educational Intelligence

CAMBRIDGE — The Adams prize (value about £240), which is awarded every two years for an essay on some branch of pure mathematics, astronomy, or other branch of natural philosophy, has been awarded to Mr A S Besicovitch, fellow of Trinity College The subject given out for the period 1929–30 was "The Theory of Almost Periodic Functions"

The Appointments Committee of the Faculty of Physics and Chemistry has reappointed Dr F C Phillips, of Corpus Christi College, University demonstrator in mineralogy

The Vice Chancellor gives notice that the professorship of mineralogy and petrology has been established, and that a meeting of the electors will be held on June 24 The professorship is governed by Statute D and by the regulations which were approved by Grace on April 24, 1931 The stipend of the professor is £1200 a year or, if he holds a fellowship with dividend, £1000 a year

Candidates are requested to communicate with the Vice Chancellor on or before Friday, June 19 No testimonials or references need be sent If a candidate desires to submit any, they should not exceed four in all, and in the case of testimonials, ten copies of each should be sent to the Vice Chancellor not later than June 19

LONDON —The Court of the University has appointed Mr Charles Holden, senior partner of the firm of Messrs Adams, Holden and Pearson, of 9 Knightsbridge S W to be the architect of the new buildings which the University proposes to erect on its site in Bloomsbury, on the north side of the British Museum Mr Holden's task will be a large one When building operations begin, the site will be an island one of more than ten acres, bounded on the south by Montague Place, on the west by Malet Street, on the east by Russell Square and Woburn Square, and on the north by Gordon Square and Byng Place Among the first buildings to be erected will be the Administrative Offices, the University Hall, and the University Library, premises for the Officers' Training Corps, and buildings for the Institute of Historical Research and the Courtauld Institute of Art To these will in all probability be added the London Day Training College, and the Court's programme provisionally includes accommodation for Birkbeck College, the School of Oriental Studies, and the University Students' Union Space will also be reserved for other purposes, among which residential accommodation for students, a faculty club and residential chambers for staff will be considered This building programme will of necessity have to be undertaken in stages, and will take many years to complete, but, with the view of ensuring that, when the work is ended, all the buildings will form part of a dignified and harmonious scheme, Mr Holden is being asked to prepare at once a design for the whole of the site

The following doctorates have been awarded *D Sc Degree in Physics* to K R Rao (Imperial College—Royal College of Science) for a thesis entitled "Analysis of the Line Spectra of certain Elements of the Third, Fourth, and Fifth Groups" (*Proc Phys Soc*, *Proc Roy Soc*, and NATURE, 1929) *D Sc Degree in Zoology* to N A Mackintosh (Imperial College—Royal College of Science) for a thesis entitled "Southern Blue and Fin Whales" (Camb Univ Press, 1929) *D Sc (Economics) Degree* to D Mitrany (London School of Economics) for a thesis entitled "The Land and the Peasant in Rumania" (Oxford Univ Press, 1930) *D Sc Degree in Mathematics* to G F J Temple for six published papers on "The Quantum Theory of the Spinning Electron"

MANCHESTER —The Manchester City Council is again offering a number of scholarships tenable in the Faculty of Technology of the University Successful candidates are required to follow a full time course leading to the degree of bachelor of technical science in the College of Technology, and matriculation or its equivalent is an essential qualification For students who have been engaged in industry, and who have attended part time day or evening classes, the scholarships are of the value of £100 per annum, while for students leaving secondary or central schools the value is £60 Both classes of scholarships are tenable for three years

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THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to Senior Studentships for 1931 Ernest C Childs for research in physics (London) Philip S H Henry, for research in physical chemistry (Cambridge), H S W Massey, for research in physics (Cambridge), Brian H C Matthews, for research in physiology (Cambridge), William V D Hodge, for research in mathematics (Bristol), and Alexander R Todd, for research in organic chemistry (Glasgow)

Birthdays and Research Centres

June 12, 1851 —Sir OLIVER LODGE, F R S, late Principal of the University of Birmingham and formerly professor of physics in University College, Liverpool

The subject which chiefly interests me is a verification of the theory that requires a flow of ether along magnetic lines of force thereby presumably affecting the velocity of light in a magnetic field The effect to be observed is, I reckon, extremely small, and would require a Fizeau interferometer with a long path in an exceptionally intense field, though the field need only last for such fraction of a second as would enable interference bands to be photographed My own experiments of 1897 were on right lines, but their power was quite insufficient To get a result, a combination of the optical skill of the late Prof A A Michelson with the intense magnetic fields produced by the genius of Dr Kapitza would seem to be necessary, and perhaps also engineering and financial aid such as the late Sir Charles Parsons at one time contemplated A positive result, if it could be attained, would be of the greatest interest and would break the prevailing monotony of negative results yielded by all recent attempts at bringing the ether to book and restoring it to its inevitable place in the scheme of Nature

June 14, 1857 —Prof J E MARR, F R S, fellow of St John's College and lately Woodwardian professor of geology in the University of Cambridge

More attention might usefully be given to the deposits containing human relics, particularly from the geological point of view This is being done, but much more is required, for, though the task of establishing time sequences and then correlating beds in different areas has been carried some way, that of restoring the physiographies of various areas in the different periods is still in its infancy

When this important work has been carried out systematically and in detail, it will aid materially in the much greater task of establishing the history of the physical conditions under which deposits were formed, epoch after epoch, during the geological ages —a work which has not, during recent years, received the attention it requires

June 14, 1877.—Prof. R. WHYTLAW-GRAY, F.R.S., professor of chemistry in the University of Leeds.

At the present time, I am much interested in developing a buoyancy microbalance of the Aston type so that it can be used for comparing the densities of gases to a high degree of accuracy even at low pressures. This method eliminates many sources of error inherent in the classical methods, and it is hoped to obtain with its help reliable values for the chemical atomic weights of a number of elements.

At the moment we are interested in the atomic weight of carbon, which on account of the presence of the isotope C^{13} must be slightly greater than the mass spectrograph value of 12.003. Data of sufficient accuracy from several gases should enable an estimate of the proportions of the two isotopes to be made.

Other researches, in which I am interested and which are being carried on by colleagues and collaborators in my section of the Department of Chemistry here, include investigations on solid phase reactions, the electrical character of smokes, the nature of the suspended impurities in air, and the vapour pressures of slightly volatile solids.

June 15, 1851.—Dr. E. H. GRIFFITHS, F.R.S., formerly general treasurer of the British Association, and president in 1906 of Section A (Mathematics and Physics) and in 1913 of Section L (Educational Science).

I regret to state that I am not engaged in any scientific work at the present time. For many months I have been suffering acutely from arthritis, so much so that I am unable to write.

For several years past, I had proposed an investigation into the specific heat of gases at high temperatures. As it is now impossible for me to undertake such an inquiry, I hope that some younger and more able man will attack this difficult subject.

June 18, 1858.—Prof. A. R. FORSYTH, F.R.S., emeritus professor of mathematics in the Imperial College of Science and Technology.

In differential geometry, the expression

$$ds^2 = Edp^2 + 2Fdpdq + Gdq^2,$$

where E, F, G are functions of parameters p and q, represents the general arc on any surface in flat triple space, subject to three known conditions involving the coefficients in the associated quadratic differential form for the curvature of a superficial geodesic. An arc on any surface, in any domain whether flat or curved, is represented by the same formal expression. It is important to obtain the conditions which must be satisfied in order that the represented surface may exist: either (i), in a given curved triple space, itself existing in a flat space of four dimensions; or (ii), in a flat space of four, but not fewer than four, dimensions.

June 19, 1897.—Mr. C. N. HINSHELWOOD, F.R.S., fellow of Trinity College and lecturer in chemistry in the University of Oxford.

Investigations now in progress are connected with the mechanism of chemical changes in gases, with surface catalysis, and with the relation between reactions in the gaseous state and the corresponding changes in solution. Among gas reactions, oxidation processes are being specially studied at the moment, particularly with reference to the theory of 'chains', and the nature of the curious explosion phenomena encountered in such systems as hydrogen-oxygen mixtures is being examined. The influence of negative catalysts and of surfaces on these effects is gradually yielding information. Some of the earlier work on reactions depending on simple molecular collisions is being extended in the light of more recent knowledge.

Societies and Academies.

LONDON

Physical Society, April 17.—E. G. Richardson: Edge tones. If a fluid leaves an orifice as a jet and strikes an edge, two vortex streets are formed on each side of the wake and maintain the jet in pendulation at a definite frequency. The tones so produced are examined from theoretical and experimental points of view, and relations connecting the frequency with (*a*) velocity, (*b*) distance from orifice to edge, (*c*) width of orifice, (*d*) form of the orifice, are tested. All the features of the phenomena can be explained in terms of the hydrodynamics of a viscous fluid, without compressibility being postulated in addition.

Geological Society, May 6.—C. A. Matley: The geology of the country around Mynydd Rhiw and Sarn, South Western Lleyn (Carnarvonshire). The region described includes a ridge of high ground which attains a height of 994 feet on Mynydd Rhiw. Much of the lower ground is covered by glacial drift. The sedimentary rocks are of Arenig and Lower Llanvirn age, and range from the Extensus Zone to a high part of the Bifidus Zone. The local base of the Arenig is found at only one small exposure, and there it rests on the mica-schists (Penmynydd Zone) of the Mona complex. In the Hirundo Zone, and extending into the Bifidus Zone, is the Rhiw volcanic group, in which four lava flows have been found, as well as rhyolitic ashes and ashy sediments. Intrusive rocks are abundant, and range in composition from acidic to ultrabasic; they are linked genetically by their common richness in soda, and can be considered, with the volcanic rocks, as varied members of one spilitic suite. They include the Sarn granite, numerous albite-dolerite sills, and the coarser grained intrusions of picrite, proterobase, and hornblende dolerite which are found only at the top of the sequence. These intrusions are discussed, and the possibility considered that they may be a single sill or laccolith broken and displaced by faulting.—E. Greenly and P. G. H. Boswell: An Ordovician grit from Anglesey, with its bearings upon palæogeography, and upon the tectonics of the Mona complex. The grits at the base of the Arenig beds at Berw, near Holland Arms, are exceptionally rich in heavy minerals. Garnet, sphene, and epidote are abundant, as are ilmenite, biotite, and white mica. The felspars are orthoclase, albite, and olioclase. There are also small pebbles of Penmynydd Zone mica schist, Gwna green schist, and many of granitoid acid gneiss. The evidence both of minerals and rock fragments points to the acid gneisses as the principal source, with contributions from the Gwna beds and the acid members of the Penmynydd Zone. The evidence furnishes unexpected confirmation of a tentative hypothesis, already put forward, that the gneiss of Holland Arms, instead of having been brought up from below, has been brought down from above, on an infold of the Newborough slide, from the inverted upper limb of the Bodorgan recumbent fold.

CAMBRIDGE

Philosophical Society, May 18.—J. D. M'Gee: The charges of recoil atoms in relation to surface conditions. The charge carried by α ray recoil atoms of radium *D* escaping from a source of radium *C* is one positive unit when the source is deposited on a clean nickel or platinum surface. The direct method of collecting a beam of particles from a source in a Faraday cylinder and comparing the charges received by it, when the recoil atoms and α rays were successively eliminated from the beam, was used. The charge carried by a

recoil atom can then be compared with that carried by an α particle The charge carried by a recoil atom is influenced by the work function of the surface from which it escapes The cause of earlier conflicting results has been traced to the presence of high energy ions —**J E I Cairns** Conduction along thin metallic films Experiments on the electrical conductivity of thin films of cadmium and nickel showed good agreement with the theory of Ehrenberg and Honl, if it be assumed that for very thin films aggregation of the metal into small crystals with intervening gaps occurred The ageing of cadmium is anomalous and can only be attributed to internal rearrangement among the crystal aggregates forming the film Nickel, however, shows regular behaviour, and in every case after deposition its conductivity decreased, usually reaching a steady value in 4–5 minutes Composite films consisting of a low work function metal upon a higher one gave interesting results —**N Feather** Concerning the success of the absorption method of investigating the high velocity limit of continuous β ray spectra Simple absorption measurements, interpreted on the basis of the range energy relation for homogeneous particles, lead to satisfactory estimates of the maximum energies represented in the continuous spectra of many β ray bodies Calculations show that this empirical result follows from the known form of the absorption curve for homogeneous particles, the known relation between extrapolated range and energy for such particles, and the most general considerations regarding the characteristics of measuring instruments usually employed —**P S H Henry** The specific heats of diatomic gases A short summary is given of the theory of the specific heats of diatomic gases on classical and on quantum mechanics This is followed by a description of a flow method of measuring specific heats due to P M S Blackett, and some results obtained with it for air, nitrogen, oxygen, and methane between 20° C and 350° C are shown These disagree markedly with the results of sound velocity measurements, and are in closer, though not exact, accord with theory —**E L C White** A method of continuous observation of the equivalent height of the Kennelly Heaviside layer Wireless 'echoes' from the Heaviside layer are observed in the form of a stationary pattern on a cathode ray oscillograph screen, from which the height of the layer at any instant is seen at a glance

EDINBURGH

Royal Society, May 4 —**L R Cox** A contribution to the molluscan fauna of the Laki and Basal Khirthar groups of the Indian Eocene The paper describes the molluscan fossils collected by Lieut Col L M Davies from the Laki group (Lower Eocene) and lowest beds of the Khirthar group (Middle Eocene) of several districts in north western India, supplemented by material from other collections in the British Museum The work of d'Archiac and Haime (1854) on mollusca from these beds is also revised Forty five gastropod and 54 lamellibranch species, mainly from the Laki group, are described, 16 gastropods and 7 lamellibranchs being new to science Few species range up from the underlying Ranikot group, but this may be due partly to a change in facies The difference between the faunas of the Laki and Khirthar groups is less pronounced, many species occurring in both series Thirty five of the gastropods and 28 of the lamellibranchs described are known only from India, and the gastropods include certain genera not known from other countries, one genus is described as new Several of the species recorded occur also in southern Europe, and one or two as far afield as Jamaica; a few very widespread forms occur also in northern Europe The affinity of the fauna with that of the Eocene of Egypt and, more especially, of Somaliland is closer than with that of Europe —**H Boschma** On the identity of *Sacculina triangularis* and *Sacculina inflata* Specimens of *Sacculina triangularis* (Anderson, 1862) on *Cancer pagurus* from the Firth of Forth were examined, and it is concluded that *S triangularis* is identical with *S inflata* (Leuckart 1859) on *Hyas coarctatus* The valid name of the species is therefore *S inflata* This species differs from *S carcini* by constant specific characters —**S Williams** An analysis of the vegetative organs of *Selaginella grandis* Moore, together with some observations on abnormalities and experimental results The plant of *S grandis* consists of a dichotomously branched shoot showing a basal decumbent portion bearing rhizophores, an erect dichopodial axis, and a distal fan shaped region with middle shoots The apex of the stem possesses two four sided initial cells Branching is dichotomous and at each branching an angle meristem is formed The latter gives rise to rhizophores at the basal branchings and to middle shoots at distal branchings Roots arise endogenously in the tips of the rhizophores The root apex has three initials a calyptrogen, dermatogen, and a common initial for plerome and periblem Abnormal developments of the middle-shoot and proliferations of vegetative and cone apices occur, and it is also possible to obtain such deviations from the normal by experimental methods The general morphology of the plant is discussed and it is concluded that the rhizophore is an organ *sui generis*, indifferent in nature —**L M Milne-Thomson** Operational solution of the homogeneous linear equation of finite differences by generalised continued fractions Given a homogeneous linear finite difference equation of the second order, a continued fraction, constructed from the coefficients, can be made to yield a solution of the equation in terms of the initial values of the dependent variable By associating a suitable operator with the co-ordinates of a point in space of m dimensions, the notion of continued fractions is generalised to this space and an operational solution of the linear difference equation of the mth order is obtained —**Dr A C Aitken** Further numerical studies in algebraic equations and matrices The paper follows up a similar paper of five years earlier, simplifying the former methods by using the dual properties of symmetric functions, and proposing now to evaluate all the roots of an equation by subjecting the coefficients to a uniform repeated process of cross multiplication and division The process is a special case of the method of finding the latent roots of a matrix by raising the matrix to high powers The numerical work suggests a theorem in matrices which is demonstrated, namely, that the rational canonical form of a matrix can be transformed at once into the classical irrational canonical form, the transforming matrix being of alternant type —**D Meksyn** Electromagnetic phenomena in a uniform gravitational field The radiation of an electron moving freely in a uniform gravitational field is evaluated The electromagnetic equations can be rigorously solved for this case The result obtained is Larmor's value for the rate of radiation The calculation is based on Poynting's theorem and the geodesic propagation of light The result obtained shows that the principle of equivalence can be applied to the evaluation of radiation, if allowance is made for the quantum properties of light.

DUBLIN

Royal Irish Academy, April 27.—**J K Charlesworth** A tentative reconstruction of the successive margins of the quaternary ice sheets in the region of the North Sea. The outer limit of the British drift is composite During the Saale-upper older drift period the ice margin over the North Sea was cusp-shaped. During the period of the newer drift of Britain—

Brandenburg or Warthe stage of north-west Europe—when the edge of the Scandinavian ice lay off the west coast of Norway, the British ice formed an independent piedmont mass over the western half of the North Sea.—**A. Muskett, E. N. Carrothers, and Hugh Cairns**: Contributions to the fungus flora of Ulster. A report of work carried out from 1923 to 1931, records 312 species and 9 varieties new to Ulster, thus bringing the total up to 916, besides adding 78 species and one variety to the Irish flora. Short notes are included for each species, giving details of place and date for each record.—**K. G. Emeléus and Olive Hall**: The spectrum of the cathode glow in nitrogen and other gases. The arc spectrum of nitrogen (N I) appears strongly in the light of the cathode glow of a low voltage d.c. glow discharge, in spite of the fact that it is otherwise somewhat difficult to excite. An explanation of this is offered, based upon Kallmann and Rosen's work on interchange of charge between slow positive ions and neutral particles, which also accounts for the cathode glow spectrum in a number of other polyatomic gases and mixtures, but fails to explain adequately the thickness of the cathode glow. The bright flecks which form at points where a discharge strikes to the rear of the cathode have been shown to be local plasma type discharges.

Royal Dublin Society, April 28.—**W. R. G. Atkins**: Some experiments on the accuracy obtainable with gas filled photoelectric cells. Even using N. R. Campbell's method of postglow discharge measurements the results obtained with a thick film cæsium cell were unreliable at high voltages, though reasonably accurate for low illumination at 12 volts anode potential without glow discharge. With a G.E.C. potassium cell the sensitivity afterglow discharge decreases at first by 2·3 per cent per minute. Measurements made immediately after the discharge agreed to within 2 per cent with current about 5 μa, anode potential 59 volts; agreement was not quite so good at 166 volts.—**P. A. Linehan and S. P. Mercer**: A method of distinguishing certain strains of New Zealand perennial rye grass (*Lolium perenne L.*) by examination of seedlings under screened ultra violet light. Seedlings of the valuable Hawke's Bay district New Zealand perennial rye grass may be distinguished from the inferior strains from other districts by growing them on white filter paper and examining under screened ultra violet light. Only a very small percentage of the Hawke's Bay seedlings render the paper fluorescent, whereas a large percentage of seedlings of other varieties do so.

CRACOW

Polish Academy of Science and Letters, Jan. 5.—**Mlle. M. Kaczyńska**: Retarded luminescence in carbon dioxide. The time during which the light persists in the observation tube may reach 8 sec.; this time diminishes as the pressure of the gas in the tube increases.—**A. Skapski**: The charcoal adsorption of a weak electrolyte in saline solutions.—**E. Kurzyniec**: Study of the system calcium bismuth. From the thermal analysis of calcium bismuth alloys it is concluded that the system contains two components, Ca_3Bi_2 and $CaBi_3$.—**K. Dziewoński and L. Sternbach**: Researches on the ketones, acetyl derivatives of the bromonaphthalenes.—**W. Swietoslawski, A. Piltz, and F. Kraczkiewicz**: Methods of synthesis of sulphonic derivatives of naphthoquinonechlorimines.—**J. Elkner**: Researches on the basophil conjunctive tissue in the human larynx.—**F. Rogoziński**: Experimental rickets. Comparison of some diets producing rickets.—**L. Sitowski and St. Runge**: *Spiroptera microstoma* in the stomach of an embryo of the horse aborted at seven months.

Official Publications Received.

BRITISH

Annual Reports on the Progress of Chemistry for 1930. Issued by the Chemical Society. Vol. 27. Pp. 389. (London.) 10s. 6d. net.

British Science Guild. The Annual Report of the Council of Management, 1930–31, presented at the General Meeting of Members held at the Offices of the Western Electric Company, Bush House, London, W.C.2, on Tuesday, 12th May 1931, at 5.30 p.m. Pp. 27. (London.) 1s.

Transactions of the Optical Society. Vol. 31, No. 5, 1929–30. Pp. 241–268+xvi+vi. (London.) 10s.

A List of Official Chemical Appointments. Compiled by direction of the Council of the Institute of Chemistry and under the supervision of the Publications Committee. Seventh edition, revised and enlarged. Pp. 402. (London: Institute of Chemistry.)

Journal of the Indian Institute of Science. Vol. 13A, Part 15: i Biochemistry of Tan Liquor Fermentation, by P. D. Dalvi; ii Note on the Estimation of Tannic and Gallic Acids, by P. D. Dalvi. Pp. 171–195. (Bangalore.) 1.4 rupees.

The Indian Journal of Veterinary Science and Animal Husbandry. Vol. 1, Part 1, March. Pp. vii+62+5 plates. (Calcutta: Government of India Central Publication Branch.) 2 rupees; 3s. 6d.

The Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W.15. Annual Report and Accounts for 1930. Pp. 84. (London.)

The Carnegie United Kingdom Trust. Seventeenth Annual Report (for the Year ending December 31st, 1930) approved by the Trustees on Friday, March 6th, 1931. Pp. ii+103+8 plates. (Dunfermline.)

The Journal of the Institute of Metals. Vol. 44. Edited by G. Shaw Scott. Pp. xii+880+51 plates. (London.) 31s. 6d. net.

Home Office. Criminal Statistics, England and Wales, 1929. Statistics relating to Crime, Criminal Proceedings and Coroners' Investigations for the Year 1929. (Cmd. 3853.) Pp. xxxii+197. (London: H.M. Stationery Office.) 3s. 6d. net.

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 13. Pp. 51. (Hertford: Stephen Austin and Sons, Ltd.)

FOREIGN

Transactions of the San Diego Society of Natural History. Vol. 6, No. 19: Report on a Collection of Land Birds from Sonora, Mexico. By A. J. van Rossem. Pp. 237–304. Vol. 6, No. 20: A New Subspecies of the California Boa, with Notes on the Genus Lichanura. By Laurence M. Klauber. Pp. 305–318+plate 21. Vol. 6, No. 21: A Molluscan Species new to the recent West Coast Fauna. By Don L. Frizzell. Pp. 319–324+plate 22. (San Diego, Calif.)

U.S. Department of Agriculture. Miscellaneous Publication No. 11: Information for the Guidance of Field Men and Cooperators of the Bureau of Biological Survey engaged in the Control of Injurious Rodents and Predatory Animals. Prepared under the direction of Paul G. Redington. Pp. 8. 5 cents. Technical Bulletin No. 233: *Apanteles thompsoni* Lyle, a Braconid Parasite of the European Corn Borer. By Arlo M. Vance. Pp. 28. 10 cents. (Washington, D.C.: Government Printing Office.)

Mellon Institute of Industrial Research. Bibliographic Series, Fourth Supplement to Bulletin No. 2: A List of the Books, Bulletins, Journal Contributions and Patents by Members of the Mellon Institute of Industrial Research during the Calendar Year 1930. By Lois Heaton Pugsley. Pp. 10. The Activities of Mellon Institute during 1930–31. Pp. 14. (Pittsburgh, Pa.)

Proceedings of the American Philosophical Society. Vol. 70, No. 1. Pp. 102. (Philadelphia.)

U.S. Department of the Interior: Geological Survey. Bulletin 820: Nitrate Deposits in Southeastern California, with Notes on Deposits in Southeastern Arizona and Southwestern New Mexico. By L. F. Noble. Pp. v+108+19 plates. 45 cents. Professional Paper 165 D: Geology of the Big Snowy Mountains, Montana. By Frank Reeves. (Shorter Contributions to General Geology, 1930.) Pp. ii+135–149+plates 35–38. 20 cents. Water Supply Paper 637 C: Water Power Resources of the McKenzie River and its Tributaries, Oregon. By Benjamin E. Jones and Harold T. Stearns. (Contributions to the Hydrology of the United States, 1930.) Pp. ii+91–124+plates 2–9. 15 cents. Water Supply Paper 645: Surface Water Supply of the United States, 1927. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+115. 20 cents. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 105: A Study on Sodium Fluosilicate with Special Reference to its Toxicity to Farm Animals. By Rizk Attia. Pp. ii+38. (Cairo: Government Press.) 4 P.T.

CATALOGUES

Catalogue of Important Zoological, Botanical and Horticultural Works. (No. 16.) Pp. 20. (London: John H. Knowles.)

The Nickel Bulletin. Vol. 4, No. 5, May. Pp. 125–160. (London: The Mond Nickel Co., Ltd.)

A List of Apparatus for Cable Testing. Pp. 31. (London: X Rays, Ltd.)

Biographies and Memoirs: a Catalogue of Biographical and Autobiographical Books, Letters and Journals, Historical and Criminal Memoirs and Family Histories. (Catalogue 537.) Pp. 80. (London: Francis Edwards, Ltd.)

Analytical Reagents, Standards and Tests. Third edition, rewritten and enlarged. Pp. 185+xviii. B.T.L. Monthly Bulletin, No. 1, May. Pp. 4. Price List of Analytical Reagents. Pp. 7. (London: Hopkins and Williams, Ltd.)

Catalogue of Lewis's Medical and Scientific Circulating Library. Supplement 1928–1930. Pp. 112. (London: H. K. Lewis and Co., Ltd.) 2s. net (1s. net to Subscribers).

A Catalogue of Book Bargains. (No. 527.) Pp. 16. (London: William Glaisher, Ltd.)

A Catalogue of Technical and Scientific Books for Engineers, Chemists, Scientists, Architects, Surveyors, etc, and Students in Colleges, Polytechnics, etc, published by John Wiley and Sons, Inc., of New York Pp 167 (London Chapman and Hall, Ltd)

Watson's Microscope Record No. 23, May Pp 24 (London W Watson and Sons, Ltd)

High Alumina Blocks of Rotary Cement-kiln Linings Pp 24 (Chatteris Algernon Lewin Curtis)

B D H Preparations of Ergot ("Ergodex" and Salts of Ergotoxine). Pp 10 (London The British Drug Houses, Ltd)

Diary of Societies.

FRIDAY, June 12.

Royal Astronomical Society, at 5 —Dr L. J Comrie Note on Mr Chappell's Method of Second Difference Integration —Bertha Swirles The Absorption Coefficient of a Degenerate Gas —G Castelnuovo De Sitter's Universe and the Motion of Nebulæ.

Royal Society of Medicine (Ophthalmology Section) (Annual General Meeting), at 5 —E Wolff Macular Detachment in Iridocyclitis

Malacological Society of London (at Linnean Society), at 6 —H H Bloomer Note on the Anatomy of *Lamellidens marginalis* Lam and *L thwaitesi* Lea.—Dr F A Schilder and J R. leB. Tomlin Rediscovery of a Rare Cowry - J R. leB Tomlin Notes from the British Museum I Dates of Certain Species of *Donax* and *Mesodesma* —Lt. Col A J Peile (a) On the Embryonic Radula of *Subulina*, (b) Note on *Clausilia thermopylarum* Pfr

Royal Institution of Great Britain, at 9 —Dr C L. Woolley Latest Excavations at Ur

SATURDAY, June 13

Biochemical Society (at Marine Biological Station, Plymouth), at 3 30 —Prof A. T Cameron Some Notes on the Rate of Decomposition of Creatine in Acid and Alkaline Solutions.—Dr P Haas and Dr T G Hill A Preliminary Note on the Nitrogen and Fat Metabolism of Sea Weeds —R. K Callow and C Fischmann The Occurrence of Fat-soluble Vitamins in Lampreys —T F Dixon and G F Marrian The Isolation of a Hydrocarbon from Urine —C R. Harington and S S. Randall (a) Isolation of *dl* 3 5-diiodotyrosine from the Thyroid Gland (b) Synthesis of the *d* and *l* 3 4 dihydroxy phenylalanines —*Demonstrations* —Dr W R. G Atkins Light Recording Instrument —Dr C M Yonge Permeability of Chitin —A D Ritchie Velocity of Pecten Muscle —L H N Cooper Determination of some Chemical Constituents of Seawater —D P Wilson Methods of Rearing Larvæ —G M Spooner Behaviour of Plankton Animals. —J E Smith Grading of Bottom Deposits —H W Harvey Rate of Growth of Diatoms

MONDAY, June 15

Royal Society of Edinburgh, at 4.30 —Prof A. H R Buller Recent Advances in our Knowledge of the Higher Fungi (Address) —J Thomson The Ionising Efficiency of Electronic Impacts in Air (*to be read by title only*).

Victoria Institute (at Central Buildings Westminster), at 4 30 - Sir Ambrose Fleming Light (Presidential Address).

British Psychological Society (Industrial Section) (at Red Lion Restaurant, Red Lion Square), at 8.—D R Wilson The Present *Trend of Industrial Psychology in Great Britain*

Royal Geographical Society, at 8 30 —Prof O Holtedahl The Work of the *Norvegia* in the Antarctic

TUESDAY June 16

Royal Society of Medicine, at 4 30 —Special General Meeting.

Royal Statistical Society (at Royal Society of Arts), at 5 15 —Prof O M W Sprague Major and Minor Trade Fluctuations

Royal Anthropological Institute, at 8 30 —Miss G Caton Thompson Prehistoric Research in the Kharga Oasis

WEDNESDAY, June 17

Society of Glass Technology (at Sheffield), at 2

Royal Meteorological Society, at 5 —Prof S Chapman A Theory of Upper atmospheric Ozone —C K M Douglas On the Relation between Temperature and Pressure in the Troposphere

Geological Society of London, at 5 30 —Prof O Holtedahl Some General Structural Features of the Arctic and Adjacent Regions (Lecture).—J A Douglas and W J Arkell The Stratigraphical Distribution of the Cornbrash II The North Eastern Area.

Folk Lore Society (at University College), at 8 —Dr M Gaster Some Oriental Folklore and Problems of Dissemination

THURSDAY, June 18

Royal Society, at 4 30.—The President and others Discussion on Recent Advances in the Chemistry of the Vitamins

London Mathematical Society (at Royal Astronomical Society), at 5 —J D Barter Canonic Expressions of *p* Vectors —F W Bradley Concerning the Distribution of Primes Represented by Certain Quadratic and Cubic Forms —S. Chowla and A Walfisz: On a Trigonometric Sum —T Estermann On the Representations of a Number as the Sum of Three or More Products.—D E Littlewood On the Classification of Algebras.

Royal Society of Tropical Medicine and Hygiene (Annual General Meeting) (at 11 Chandos Street, W), at 8 15 —Dr E Muir The Treatment of Leprosy

FRIDAY, June 19

Physical Society (at Imperial College of Science and Technology), at 3 and at 5 15 —Discussion on Audition to be opened by Dr C. S. Myers —E D Adrian The Microphonic Action of the Cochlea in Relation to Theories of Hearing —Dr R. T Beatty Auditory Mechanisms —Dr A. W G Ewing High frequency Deafness —Dr E G Richardson The Dynamical Theory of the Ear —Sir Richard A S Paget Audition in Relation to Speech, and the Production of Speech Sounds by the Human Vocal Apparatus, by Acoustic or Electrical Resonators, and by Musical Instruments.—Dr E W Scripture The Nature of the Vowels —Dr E. Meyer The Analysis of Noises and Musical Sounds —Dr C V Drysdale Acoustic Measuring Instruments.—Dr H Banister The Basis of Sound localisation. —Dr A H Davis The Measurement of Noise.—Dr F Trendelenburg Objective Measurement and Subjective Perception of Sound —Dr F Allen The Perception of Intensity of Sound in Normal, Depressed, and Enhanced States of Aural Sensitivity —G Waetzmann Über die Messung der Reiz Schwelle der Hörempfindungen mit Resonanztelephonen —Major W S. Tucker The Localisation of Sound Derived from Observations of Intensity —Prof E M von Hornbostel The Time Theory of Sound localisation A Re-statement.

Royal Society of Medicine (Physical Medicine Section), at 5 —Special General Meeting

Royal Society of Medicine (Obstetrics and Gynæcology Section), at 8 —Prof F J Browne The Zondek Ascheim Reaction in Chorion Epithelioma —Dame Louise McIlroy and Dr Gladys Hill Pregnancy Complicated with Diabetes

Royal Society of Medicine (Radiology Section), at 8 30 —Special General Meeting

SATURDAY, June 20

North of England Institute of Mining and Mechanical Engineers, at 2 30

Royal Society of Medicine (Orthopædics Section) (at Oxford)

PUBLIC LECTURES.

FRIDAY, June 12

London School of Hygiene and Tropical Medicine (Public Health Division), at 5 —Sir Thomas Legge Industrial Poisonings

TUESDAY, June 16

London School of Hygiene and Tropical Medicine (Public Health Division), at 5 —Sir George Buchanan International Hygiene

Institute of Pathology and Research (St Mary's Hospital W 2), at 5 —Dr B Hart The Causation of Neurotic Disorders

WEDNESDAY, June 17

Faraday Society (at Royal Institution) at 5 30 —Dr R I Mond Michael Faraday (Spiers Memorial Lecture)

FRIDAY, June 19

London School of Hygiene and Tropical Medicine (Public Health Division), at 5 —Sir Thomas Legge Industrial Poisonings

CONFERENCES.

June 10 to 13

South Eastern Union of Scientific Societies (at Winchester).

Friday, June 12 (Geological Section), at 10.30 A M —Prof H L. Hawkins Some Generalisations on the Nature, Deposition, and Palæontological Implications of the Chalk

At 11 45 A M —F H Edmunds The Relation of Soil and Geology of the Weald

(Zoological Section) at 10 30 A M —J F Marshall The Stereoscopic Photomicrographs of Fossil Insects exhibited in the Congress Museum

At 11 A M.—H Main Insect Observations Underground

At 12 —E A Martin The Making of Pearls

At 8 P M —W P D Stebbing A Motor Tour of 7500 miles from the Transvaal to Western Uganda (Public Lecture)

Saturday, June 13 (Regional Survey Section), at 11 A M —H J E Peake Archæological Surveys.

June 15 to 18

International Union for the Scientific Investigation of Population Problems (at Royal Society of Arts) —The first three morning sessions will be devoted to official business, and the afternoon sessions and the whole of June 18 to reports and papers relating to the work of the Union Commission 1 (Population and Food Supply) reports on the first afternoon, Commission 2 (Differential Fertility) on the second afternoon, and Commission 3 (Vital Statistics of Primitive Races) on the third afternoon Papers to be read on these afternoons and those for June 18 include studies on Differential Fertility in Stockholm, the Birth rate and Population of the United States, and Vital Aspects of a Chinese Family Population during six hundred years, general papers on Population Theory and Human Biology, and Experimental Work on Mice Populations

SUMMER MEETINGS.

June 11 to 13

Newcomen Society for the Study of the History of Engineering and Technology (at Sheffield).

June 17 to 19

Institution of Water Engineers (at Harrogate)

Wednesday, June 17 (at Hotel Majestic), at 10.30 A.M —H Prescot Hill Presidential Address.

E. Sherman Chase Modern Aspects of Water Purification

C. M Saville Modern Dam Construction.

Afternoon —F W Macaulay The Construction of Modern Water Mains.

H A. P Hetherington The Sinking of Borings.

SATURDAY, JUNE 20, 1931

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Progress and Prejudice.

SIR ARTHUR KEITH'S rectorial address on "The Place of Prejudice in Modern Civilisation", delivered on June 6 to the students of the University of Aberdeen, bore challenge in its title and in its matter was boldly provocative He was conspicuously courageous in attacking the gravest of the world problems of to-day—the future of international relations—from the point of view of the thorough going evolutionist Drawing on his studies of racial evolution from prehistoric times onward, he gave it as his considered opinion that race prejudice has to be given a recognised place in modern civilisation He postulated a continuance of tribal rivalry and competition as an essential of progress in the future

Sir Arthur's address teemed with phrases which almost charm acquiescence by their terse epigrammatic quality "Without competition mankind can never progress, the price of progress is competition", "Race prejudice and national antagonism have to be purchased, not with gold, but with life", "Nature keeps her human orchard healthy by pruning—war is her pruning hook" The last metaphor was not slow in moving criticism A correspondent in the press at once pointed out that a pruning hook removes dead and useless wood while war does the reverse Arboricultural experts may differ as to the exact function of a pruning hook the biologist and the demographer will agree as to the function of war in helping to preserve the equilibrium of population, environment, and food supply The anthropologist, too, would be at no loss for examples to show that the abolition of tribal war under white administration has had an adverse effect in removing checks on an excessive growth of population, as in parts of South Africa, or by eliminating the zest of life and opening the way to racial decay, as in Melanesia The price is undoubtedly heavy, and the results of the last war make it imperative that we should count the cost In so doing, no side of scientific argument may be neglected If Sir Arthur Keith's dicta, when torn from their context, seem needlessly ruthless, it is a ruthlessness which is due to the facing of facts, for Nature sacrifices the individual that the race may survive, and so in the long run does Society

No one with any sense of history could have believed that the War was "a war that would end war" Yet a generation has grown up since 1918 of which a considerable section believes that war in future will be averted by the growth of public

opinion Another section, and that too very considerable and far from being entirely of the post-War generation, looks to internationalism to act as a preventive Not the whole of this latter group rests its hope on a sentimental idealism For some its end is to be attained through the application of scientific principles They would weld the peoples of the world into a single tribe But what does this imply? As Sir Arthur puts it, "To obtain universal and perennial peace—the price is the racial birthright that Nature has bestowed on them" All peoples, black, yellow, brown, and white, must pool their blood In other words, intermarriage and the elimination of the present distribution of the peoples of the earth into races must produce a world populated by closely related hybrids, so closely related, in fact, that strife, in theory, becomes impossible

Passing over the undoubted fact that members of the same family have been known to quarrel, we may point out that the facts of miscegenation in man are at present sufficiently obscure to warrant some hesitation at cross-breeding on such a colossal scale, especially as knowledge at the present moment does go so far as to suggest that some crosses, at least, do entail a certain amount of degeneration from the higher of two standards where there is any considerable difference between the two But even granting that future research in such a subject, for example, as the distribution of the blood groups, should prove competent to suggest lines upon which cross-breeding might be practised on a large scale without the danger of wholesale deterioration, a long time would have to elapse before a scientifically directed control would be able to regulate marriage as efficiently as racial prejudice has succeeded in barring marriages by state legislation in the United States of America, when one of the would-be contracting parties can be shown to have a strain of colour inherited from even a remote ancestor of many generations back

The colour problem is the most momentous of all those into which the question of race prejudice enters, and it is no exaggeration to say that the future of our civilisation depends upon its successful solution Clearly, however, Sir Arthur Keith had more directly in view the urgent problem of the relations which are to subsist in the nearer future between the nations of western civilisation

Whatever may be the ideals of the internationally minded, it is impossible to evade the fact that race prejudice is deep seated, and that, owing to its survival value, it has been, and will continue to be, paramount As Sir Arthur phrased it, the prehistoric world in which man's tribal heart was fashioned was organised by Nature for the evolution of new and better races of mankind The 'tribal heart' still beats to-day It is the functioning of the strongest instinct which has been implanted in man, working through the group of which each individual is a member—the instinct of self-preservation

It would appear that the evolutionist has but cold comfort to offer the apostle of peace who pins his faith to the obliteration of race prejudice and national antagonisms On an evolutionary view of human progress, the attempt to form a League of Nations at the present juncture in the world's history is a break in an ordered advance It departs from the line of racial evolution and social development alike We must view race not as static but dynamic In the conditions of human society the mingling of racial types produces endless variation The nation represents a stage in racial evolution in which various racial strains—for anthropologists are agreed that there is now no such thing as a pure race—are being moulded so as to verge towards a common type, varying more or less widely in individuals, as in England, and closely bound by a common language and common institutions

Yet it is evident that the world is becoming ripe for change When we pass in review the history of humanity in the light of the teaching of social anthropology, it becomes manifest that there is in social institutions a regular progression and a constant movement to extend the feeling of solidarity over an ever increasing range from family to kin, from kin to tribe, and so forth, until we come to the nation and the Empire Now we are approaching the battle of the greater units For nearly a generation there have been movements in various parts of the world to burst the bonds of nationalism and to reach out to a greater unity in Pan-Turanian, Pan-Moslem leagues, and the like The Union of Soviet Republics, not content with the bounds of the old Russian Empire, seeks in time to embrace the workers of the world The League of Nations itself is symptomatic of this urge, but if the evolutionary view be right, it asks too much at the present stage of human development If Sir Arthur Keith is correct in his view of the trend of racial evolution, in regarding the English speaking peoples as the future custodians of peace, so far as they represent an advance in the evolutionary scale, he has the support of science and of sentiment alike

A Theory of Money

A Treatise on Money By John Maynard Keynes Vol 1 *The Pure Theory of Money* Pp xvii + 363 Vol 2 *The Applied Theory of Money* Pp viii + 424 (London Macmillan and Co, Ltd, 1930) 15s net each vol

MR KEYNES'S "Treatise on Money", the fruit of his study and reflection up to date on the part played by currency and credit in contemporary civilisation, is the most important work on monetary theory published since the War, certainly in England and probably throughout the world Its two volumes, entitled respectively "The Pure Theory of Money" and "The Applied Theory of Money", are divided into seven books The first book is concerned with essential definitions, the second investigates what the value of money really means, and how its fluctuations may best be measured, the third and fourth books—which contain the heart of Mr Keynes's theory—deal with the factors which determine the value of money and the dynamics of changing price levels, the fifth and sixth are taken up with a study of the statistical and non-statistical data bearing on changes in the quantity of money and its velocity of circulation, in the volume of production and trade, and in the rate of investment, while the seventh and last book contains Mr Keynes's proposals for the practical reforms which he would like to see the ultimate monetary authorities of the world adopt in order to achieve the objectives at which, in his opinion, monetary policy should aim

To state Mr Keynes's theory both briefly and accurately is impossible A technical subject demands technical terms whose precise definition cannot be short But subject to the *caveat* that almost every expression used in the quotation which follows requires elaboration, the kernel of his doctrine is that "the price level of output depends on the level of money incomes relatively to efficiency, on the volume of investment (measured in cost of production) relatively to saving, and on the 'bearish' or 'bullish' sentiment of capitalists relatively to the supply of savings deposits in the banking system" (vol 2, pp 345-6) In this statement it is implied by Mr Keynes's earlier chapters (*a*) that windfall profits or windfall losses (themselves highly complex concepts) are excluded from money incomes and from savings, (*b*) that investment represents real additions to the capital stock of the country or countries concerned, and (*c*) that savings deposits are true savings deposits and not merely the funds labelled by banks with this name for various extraneous reasons, while (*d*) 'bearishness' denotes the excess of the public's desire to hold liquid claims to cash rather than securities which are expected to decline in value over the amount of cash available for this purpose in the form of savings deposits, and 'bullishness' means the converse

In at least three respects this new theory of money marks a distinct advance over the principal alternative theories which have hitherto held the field First, it is excellent that so eminent an economist should have abandoned the arid rigours of the unabated quantity theory of money and exposed the barrenness of the algebraic identities in which that theory is usually formulated In the second place, the emphasis placed on the importance of the relationship to the value of money between savings and investment on one hand and the volume of consumption and investment goods produced on the other, opens fertile and promising avenues to further investigation Lastly, by demonstrating that modern banking plays a dual rôle, acting both as the supplier of current cash for depositors and as the purveyor of short loans mainly for working capital for industrial and trading borrowers, the new theory straightens out an old confusion and throws into relief an element which can and will be utilised in the course of time to guide and control economic activities much more successfully than they are guided and controlled to-day

Nevertheless, Mr Keynes's analysis as a whole appears to the present writer to be neither conclusive nor satisfactory, and to him at least it seems to break down in several vital places For example, Mr Keynes claims to have proved that if investment exceeds or falls short of savings, profits or losses (in his sense) must respectively arise in respect of output as a whole At the crucial stage in his proof, however, he apparently abandons the analysis and formulæ he has taken pains to establish in the preceding pages, and tacitly introduces a new set of assumptions which either imply a novel (and wholly undeveloped) theory as to the relationship between new savings and dealings in existing securities, or else boil down to the doctrine that additional supplies of bank money injected into the economic system tend to raise prices, and conversely The former alternative—a novel theory about savings and securities—is too embryonic to be susceptible of criticism the latter alternative—the addition or withdrawal of bank money—assumes the conclusion in the

premises, and is an obvious truism, but one which leaves the relationship which he alleges to exist between investment, savings, and profits (or losses) totally unproved Although the exposition (cf vol 1, chap 10, section (iii), and particularly p 145) is so inordinately obscure that it is practically impossible to arrive at Mr Keynes's exact meaning, even the most sympathetic reader cannot escape the uncomfortable feeling that one of the corner stones of the entire "Treatise" is insubstantial and the underpinning shaky

Similar defects appear elsewhere, especially in Book iv, on the dynamics of the price-level Here rigorous demonstration is impossible in the nature of things, and Mr Keynes is thrown back on the several probabilities of various alternatives The argument is extremely difficult to follow or to assess, but its upshot is a description of the genesis and development of a credit cycle which at best is ingenious and plausible but which can scarcely claim to be comprehensive or final And when Mr Keynes passes from his theoretical analysis to his practical conclusions, one feels that the reforms he proposes rest on far too uncertain an analytical ground work for them to be acted upon without much closer and more careful examination by the practical men who would have to work them than they have yet received

One further observation may perhaps be permitted Here, devoting itself to the analysis of a subject vital to the very well-being of modern industrial civilisation, and backed, moreover, by a pen of superb literary skill and facility, is a mind as brilliant, as powerful, and as subtle as any mind that has ever been occupied with economic subjects Yet the result of its labours, prolonged over years, is inconclusive and in many respects disappointing Why should this be? Can it be that somehow Mr Keynes, for all his gifts, has just overlooked the philosopher's stone? Or is it that there is no philosopher's stone at all, that the technique of quasi mathematical analysis breaks down when applied to monetary affairs, that in its modern monetary studies the Cambridge school of economists, the most distinguished and honoured modern representative of which is before us, has been exploring not a broad highway but a blind alley? Mathematics, provided it is given the right abstractions to manipulate, has proved itself by results to be the most powerful instrument of thought mankind has yet devised But if the mathematical method is to succeed, it must start off with the right abstractions, and if it begins with the wrong ones, then all that emerges is a will o'-the wisp pseudo science such as astrology Can it be that modern monetary theory has started off with the wrong abstractions? Or are the initial abstractions right enough so far as they go, but too fragile to support the towering fabric of theory which has been erected upon them?

By far the most interesting, freshest, and most instructive sections of Mr Keynes's book are those in which he examines the too scanty existing facts which throw light on the actual movements of various monetary and non monetary elements in economic life Whatever answer different people may return to the questions just asked, there can be no doubt at all that what monetary science now requires is further and more intensive study of the facts now available, and, as Mr Keynes earnestly pleads, more facts supplied by bankers and others for economists to study Until the facts which are urgently needed have been supplied and analysed much more thoroughly than to-day, not even Mr Keynes's genius can reduce the intricacies of this theory to the simple and (where possible) quantitative propositions which alone the common man can understand and utilise in the conduct of practical affairs JULES MENKEN

'Organismal' Conception of Development

The Interpretation of Development and Heredity a Study in Biological Method By Dr E S Russell Pp vi + 312 (Oxford Clarendon Press, London Oxford University Press, 1930) 15s net

IN some branches of biology the relevant data can be pieced together without the aid of any very comprehensive conception of the structure or potentialities of the living organism The study of animal development, on the other hand, constantly provides facts which require, for their interpretation, a definite conception of broad biological principles The developing embryo has potentialities often only revealed in the laboratory, and not infrequently it exhibits, in a striking manner, the subordination of parts to the requirements of the organism as a whole To state that the activities of an organism are something more than an integration of the activities of all its parts, is perhaps a truism, but in Dr Russell's pages it is the central theme of an extremely interesting and careful argument which leads to the establishment of the organism as the only fundamental and valid unit in biology If we accept this conclusion, we reach what the author calls the 'organismal' conception of development, which gives us "rules of method for

the study of living things and their parts without implying any mysterious 'action of the whole' on those parts" We can "accept the simple facts of observation that the organism acts as a whole and that the activities of its parts are subordinated to and co-operate in whatever the organism as a whole is doing at the moment of observation It is from this simple and objective point of view that we must regard the relation between the organism and its cells and energids"

The author's position is, in a sense, impregnable All attempts to portray the facts of development against a background of physics and chemistry have so far failed, whilst the conception of developmental organisers has done much to strengthen the attack on current materialism Dr Russell develops the attack with vision and with vigour He does not stand alone We read, with a feeling of security, that "many of the necessary concepts of 'organismal biology' are in use by biologists especially of the older and sounder tradition", they only require freedom from "any tinge of materialism that may cling to them" Those who feel that they are old enough and sound enough will read Dr Russell's sentence of death on the 'gene' without a quiver of regret, whilst his rejection of the analytical principles which dominate the sciences of physiology and biochemistry will be a timely warning to irresponsible youth All units, except the organism itself, must be swept away if we are to retain an adequate conception of development Molecules, enzymes, genes, chromosomes, cells, and organs all play their part and all are legitimate objects of study by those who are not primarily interested in the most fundamental truths of biology they are no more than the individual words of a sentence—the real meaning of which lies outside the individual components Dr Russell's argument is vigorous and stimulating, it is set forth with scholarly judgment

Most biologists are probably willing to admit that some type of 'organismal' outlook provides a deeper insight into the problems of development than does any other theory, but it is not clear how this conviction leads to the discovery of new facts Theories are ephemeral, facts remain, and it is as a working hypothesis that Dr Russell's conclusions must stand or fall In the meantime, his book will stimulate thought and suppress ultra-materialistic dogma, and this in itself is a very real contribution to biology

It is not difficult to criticise adversely selected passages from a work which not only defines the point of view of its author but also of most of the more eminent biologists of the past Some may think that the author's conception of the chomosome theory of inheritance is an inadequate representation of the established facts, and it may be that when Dr Russell is most vigorous he is least sound Others may be unconvinced that the analytical method is obsolete or unreliable There may even be some who will fail to read the first three chapters without a yawn Those, however, who are not unduly prejudiced in favour of materialism will read the whole book with pleasure, and congratulate its author with more than usual sincerity

J GRAY

A History of Elementary Mathematics

Geschichte der Elementar-Mathematik in systematischer Darstellung mit besonderer Berücksichtigung der Fachwörter Von Dr Johannes Tropfke Band 1 *Rechnen* Dritte, verbesserte und vermehrte Auflage Pp vii + 222 (Berlin und Leipzig Walter de Gruyter und Co, 1930) 12 gold marks

IT is a remarkable testimony to the excellence of this work that a third edition should have been called for within nine years of the issue of the first volume of the second edition (1921) The first edition, in two volumes, appeared in the years 1902 and 1903 and contained about eight hundred pages The second edition was published in seven parts or volumes (1921–24) and ran to nearly thirteen hundred pages in all, the increase being due to the incorporation of the results of new researches into the history of mathematics carried out in the meantime The first part of the present edition contains 222 pages, as compared with the 177 pages of the first part of the second edition, which again shows that the author has included a large amount of fresh material

The preface to the first edition described the plan and intention of the work There were previously available three volumes of the monumental work of Moritz Cantor, the first attempt in recent times to concentrate in one book the vast material existing in earlier histories which had become antiquated (Heilbronner, Montucla, Kastner, Arneth, etc), and in a multitude of scattered articles dealing with separate questions But the great scope of Cantor's undertaking precluded him from entering into great detail, and one effect of its publication was to call forth a number of new works, some of which helped to fill up gaps, while others took the form of histories of separate subjects, for example, Braunmühl's "History of Trigo-

nometry" The strict chronological order followed for the most part in Cantor's work constituted a great difficulty in the way of the reader who wished to inform himself on any particular point at short notice, since the information had to be laboriously gathered together out of a number of different chapters in the book, with the help of the index For a reference book, therefore, which should enable a student to get light on this or that point without loss of time, a systematic arrangement according to subjects is infinitely preferable, and Tropfke's book is written from this point of view

The seven parts of the second edition divide the subjects thus (1) Calculation (numeral systems, whole numbers and fractions, arithmetical operations etc) (2) general arithmetic (including algebra, logarithms, theory of numbers), (3) proportions and equations (4) plane geometry (5) plane trigonometry sphæric and spherical trigonometry (6) analysis and analytical geometry (7) stereometry, with indices to the whole work arranged (a) according to names and works, (b) according to subjects

As the editor explains, there is no pretension to literary style the account is summary, approximating to the brevity of a lexicon the object is, above all things to catch the eye and make the salient points stand out, as it were References are given in the notes to the original authorities for the statements made the fullness of these notes will be gathered from the fact that there are 1343 notes, of various lengths to 218 pages of text in the volume before us They are brought up to dates so late as 1929 and 1930 there are references to light years as units of distance, to Eddington's calculation of the diameter of the universe, regarded as finite under the relativity theory, to the latest researches into Babylonian and Egyptian mathematics by H Wieleitner, O Neugebauer, T Eric Peet, A B Chace, Kurt Vogel, and others to B Datta's papers on ancient Indian mathematics, and so on

There are and must be omissions We have not so far traced any reference to the Russian peasant' method of multiplication (by means of duplicating and halving only), which in effect comes to the same thing as the ancient Egyptian method In citing other works, the author does not always refer to the latest editions But, taken as a whole, the work is an invaluable, nay, indispensable, *Nachschlagebuch*, and we look forward with lively interest to the appearance of the remaining parts

T L H

Our Bookshelf.

Soviet Union Year Book, 1930 Compiled and edited by A A Santalov and Dr Louis Segal Pp viii + 670 (London George Allen and Unwin, Ltd, 1930) 7*s* 6*d* net

THE 'Soviet Union Year Book", which first appeared in 1925 as the Commercial Year-Book of the Soviet Union", is a bulky and informative volume, concerned chiefly, as its origin would suggest, with matters of commercial interest There are sections on the constitutional and political organisation of the Union of Socialist Soviet Republics and of its constituent republics, on the economic organisation and development of the Union, including a short notice of the Five Year Plan and separate sections dealing with agriculture, mineral resources, industry, transport, foreign trade finance and currency, labour and co operation There is also a legal section dealing only with private law

Of most interest to readers of NATURE are probably the sections dealing with education and with health Under the former heading we read that there were in 1928–29 in the U S S R, 109 Workers' Faculties with 60,200 students, and 134 universities with 155 300 students One would be grateful if subsequent issues of the 'Year Book' gave more information concerning these institutions there is nothing here concerning their organisation, their method of recruiting students, their geographical distribution or the subjects studied in them In the same section are included the numerous scientific institutes that have been opened in the U S S R and where research is being done in problems of applied science likely to assist the industrial development of the country A list of these institutes is given and, as a sample of their activities, a summary of the work carried out in the Chemical Institute Since the summary only occupies a page and a half, our curiosity is aroused rather than satisfied

The legal section includes an account of the Soviet Union laws on copyright, trade marks, industrial designs and patents, including the full text of the most important decrees and ordinances in the matter of patents

Other interesting features are maps, showing the new political and administrative divisions of the Union and the progress of electrification a list of the more important periodicals published in the Union, including several technical and scientific ones and a Who's Who" of scientific workers The value of the 'Year-Book" as a work of reference is increased by the presence of an index

The Universe around Us By Sir James Jeans Second edition Pp x + 363 + 24 plates (Cambridge At the University Press, 1930) 12*s* 6*d* net

COMMENT on this well known book is almost a work of supererogation, the remarkable popularity it has attained, which shows no sign of abating, makes praise superfluous and adverse criticism futile

The second edition shows little modification of the original book The size is increased by eleven pages, and a number of small alterations have been made, either in correction of errors of detail or as representing the superiority of second thoughts to first The increase of size is due mainly to a discussion of three subjects, described in the preface as the new planet Pluto, the rotation of the galaxy, and the apparent expansion of the universe It is an eloquent commentary on the present progress of astronomy that, in little more than a year, subjects of this magnitude and importance have either been born or experienced developments of fundamental character There is only one point in the book to which we might profitably direct attention The index includes, under the general heading "Quotations", a number of well-known names, but reference to the corresponding pages often shows no obvious quotation Presumably the reference to George Meredith in connexion with p 283 arises from the occurrence there, without inverted commas, of the isolated phrases "dusty answers" and "hot for certainties" A 'quotation' from Matthew Arnold, assigned to p 5, eludes us If phrases which have passed into current coin of the language are to be dubbed 'quotations', there will be no end to the acknowledgments necessary One wonders, for example, why 'new heavens and a new earth" on p 331 is not ascribed to St John, or even why the Psalmist is not given the credit for "down to the sea", on p 151 The point is a small one, but it is not beneath notice It is a penalty of reaching a high standard of excellence that small blemishes become unduly conspicuous, and this may serve as a justification for mentioning one of them here

Little America Aerial Exploration in the Antarctic and the Flight to the South Pole By Rear-Admiral Richard Evelyn Byrd Pp xvi + 422 + 58 plates (London G P Putnam's Sons, 1931) 21*s* net

AERIAL exploration has introduced a new kind of book on polar travel The two-volume account of the daily routine of sledge journey and camp has gone An aerial journey is so brief that there is little to say beyond comments on the behaviour of the machine Admiral Byrd made several remarkable flights during his year in the Antarctic and discovered considerable areas of new land, yet the bulk of the volume is descriptive of preparations for winter quarters and the journeys to and from New Zealand The flight to the Pole and back, which occupied nineteen hours, is described in a single chapter

The limitation of usefulness of aerial exploration is clearly brought out in this book, and Admiral Byrd wisely supplemented it with ground work where possible Thus Prof Goold's examination of the Queen Maud range was one of the most important aspects of the work Unfortunately, the new land east of King Edward Land was not examined The expedition had its base at the Bay of Whales on the Ross Barrier, out of sight of land, so that the majority of the large complement of forty-two men never got a glimpse of Antarctic land Another innovation in Antarctic exploration was the daily contact by wireless with the outer world and the inclusion of a press correspondent in the staff The book contains little record of scientific results, which were considerable, but has much information about flying conditions

Oxydations et reductions Par René Wurmser (Les problèmes biologiques, Vol 15) Pp xix + 381 (Paris Les Presses universitaires de France, 1930) 95 francs

PROF WURMSER has produced a really excellent book on oxidation and reduction, of value not only to those interested in the physical and chemical aspects of biology but also to the general scientific reader as well He commences with the principles of oxidative and reductive processes as illustrated by changes in valency, by electron transfer, and diminution in free energy The various mechanisms of the operation of both photochemical and thermochemical processes of oxidation and reduction are then developed, and two chapters are devoted to a critical discussion of the hypotheses involving 'activation' of hydrogen and 'activation' of oxygen respectively According to the author, these theories must not be regarded as rivals, but that processes of oxidation and reduction operate by one or the other mechanism Attention is then directed to the determination of oxidation, reduction equilibria, including not only those readily reversible but also those which are only partially reversible in systems for which the evidence for reversibility is at present somewhat scanty The volume concludes with a discussion of experimental technique and a summary of the results obtained in the study of intracellular oxidation-reduction potentials The book is well written, in that it is a veritable mine of information yet at the same time eminently clear and readable The printing and binding are both superior to the average text-book of French origin

E K R

Foundations of Biology By Prof Lorande Loss Woodruff Fourth edition Pp xvi + 501 (New York The Macmillan Co, 1930) 3 50 dollars

THIS is regarded in many universities as a standard text book for the student's own reading It gives the zoologist the necessary essentials of botany, and shows an understanding of the part played by unicellular organisms The diagrams are simple and admirably selected, many being original Technical terms are reduced to a minimum, and the student is helped also by an admirable glossary The new edition is a great improvement, and the more adequate discussion of many themes will make them simpler to the student The enlargement of the section devoted to human welfare is useful We ourselves are rather tired of the evolution of the horse, in the next edition the author should explain what a horse is and how it is adapted to its environment, for his students will not know

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Observations on the Penetrating Radiation in the Antarctic.

OBSERVATIONS upon the variation of intensity of the penetrating or cosmic radiation with latitude were carried out by the B A N Z Antarctic Research Expedition during the recent summer cruise of the *Discovery*, November 1930 to March 1931

All observations during the voyage were made by Mr A L Kennedy, physicist to the expedition The apparatus employed was a Geiger Muller electron tube counter, with single-stage amplifier, relay, and automatically recording chromograph The tube counter was contained in a Pyrex glass tube, into which tungsten leads were sealed and filled with argon gas at a pressure of approximately three centimetres mercury The tube was mounted between lead blocks in such a way that, except for the holes through which the ends of the tube projected, four inches of lead surrounded the tube on every side

The pressure of the argon was adjusted to give a counting-voltage between 450 and 500 volts, and a series resistance of the order of 1500 megohms consisting of a suitably proportioned mixture of xylol and alcohol in a hermetically sealed Pyrex capillary gave potential 'kicks' for each discharge through the tube The whole apparatus was mounted in a small room on the deck of the *Discovery*, adjoining the wireless room Of six tubes made in the physics laboratory of the University of Adelaide, only one survived the voyage Fortunately, counts were obtained on this tube over a region ranging from Hobart to Adelie Land, that is, over a range of geographical latitude from 43° S to 68° S

Counts were made on thirty four days during the voyage, and the total number of 'kicks' recorded was 28,350 in a total time of 4502 minutes, giving an average rate of 6 3 'kicks' per minute Except on two occasions, when values of 7 5 and 7 2 were obtained, the variations from this mean are of the order due to probability variations, and both these high values occurred early in the voyage with values of a 'counting voltage' higher than was usual The counts for the two stations nearest to the magnetic pole, with the ship stationary off Adelie Land, show values of 5 9 per minute and 6 3 per minute There is thus no definite indication of variation with magnetic latitude

Unfortunately, an overcast state of the sky was so general that no attempt at a correlation of electron counts with auroral intensity is possible On the one occasion on which the log book records the occurrence of a brilliant aurora, the count was, however, unusually low (5 6 per minute)

The mean value (6 3 per minute) of all counts on the voyage is identical within the limits of experimental error with the value (6 1) obtained for a count of four hours in the physics laboratory of the University of Adelaide

The result of the observations thus tends to confirm those of Bőthe and Kohlhörster in the North Atlantic (kindly communicated in a letter from Dr Bőthe), of Corlin at Abisko, and of Millikan at Churchill in Canada, in showing that the intensity of the penetrating radiation does not vary to any considerable extent with magnetic latitude even within 250 miles of a magnetic pole

The accuracy of the observations probably does not exceed ten per cent at best, but it should be noted that they were taken in circumstances of exceptional difficulty, illustrated by the following extracts from the log-book "Roll 40°." "Stopped Radio transmission started" "Very big seas, stormy, rolling heavily . bottle P_2O_5 rolled on to instrument, putting it temporarily out of action."

Difficulties with regard to temperature, which affects the voltage of the H T battery, and humidity, which affects the insulation, were also formidable The former could not be controlled, but the latter was successfully countered by using sulphur as an insulating material and by surrounding the end of the Pyrex tube with a sleeve containing phosphoric anhydride

The preliminary work of adjusting gas pressure in the counting tube, determining the counting-voltage, etc , was carried out by Mr Iliffe, of the staff of the physics laboratory

KERR GRANT

University of Adelaide,
May 8

The Nuclear Moments of Cæsium, Rubidium, and Indium

IN my work [1] on the hyperfine structure of the lines of the principal series of cæsium, I suggested that $\frac{7}{2}$ was the value of i, the quantum number of the rotation of the nucleus , but I pointed out that it might well be higher, it being impossible to determine it with certainty owing to the hyperfine structure of the P levels being too fine to resolve In the meantime Schuler [2] has shown that the value of nuclear quantum number can be determined quite simply from the intensity ratio of the components of the hyperfine structure doublets In cæsium the two components are of very nearly equal intensity , so that the value of i must be high it may well be 9/2, or perhaps higher , in order to find the exact value, experiments are being made to determine very accurately the intensity ratio of the components

I have also examined the structure of the lines $1S_{\frac{1}{2}} - 3\,{}^2P_{\frac{1}{2}}$ and $1S_{\frac{1}{2}} - 3\,{}^2P_{\frac{3}{2}}$ of rubidium These possess a doublet structure with a separation of about 0 1 cm^{-1} , but the intensity ratio of the two components is about 2 1 , this corresponds to a value of 1/2 or 3/2 for i , the values of the intensity ratio being respectively 3 1 and 5 3 for these two values The structure is probably affected to some extent by the isotope of higher atomic weight , but as this is only present to the extent of about 25 per cent, the value of i for the principal isotope must still remain within the limits given

The value of i for indium [3] is given as one , this is almost certainly too low It was calculated by Goudsmid's cosine law [4] from the separations of two very close levels The ratio of these separations was found to be 0 072 ± 006 0 045 ± 006 , that is some value between 2 1 and 1 3 1 The corresponding value of i is between 1 and 7/2, if these limits of experimental accuracy are taken into consideration But here again additional evidence is given by consideration of the intensity ratios of the fine structure components , this corresponds to a high value of i It is therefore to be assumed that the upper limit of the range of values found by the cosine law, namely, 7/2, is the more probable

The experimental results are of course in no way affected by this revised theoretical interpretation.

Goudsmid has suggested that my experimental results for the hyperfine structure of indium are

uncertain, as they do not agree with some results obtained by McLennan.[5] A careful study of both works on the subject shows that the difference between McLennan's results and mine is just what is to be expected, if the lower resolving power with which McLennan worked is taken into consideration. The line 4101, I found to possess four components with separations 0·000, 0 281, 0 380, and 0 658 cm $^{-1}$ now the component at 0 380 cm $^{-1}$ is weak and very close to the component at 0 281 cm $^{-1}$; consequently, except with very fine lines and high resolving power, it could not be observed and the line would appear to possess only three components, as McLennan observed Similarly, in the case of the line 4511, I observe four components, while McLennan only observed two, now the separations of the four components are 0 000, 0 045, 0 204, and 0 276 cm $^{-1}$ here the components at 0 000 and 0 276 cm $^{-1}$ are weak and very close to the strong components at 0 045 and 0 204 cm $^{-1}$, so that except with the highest resolution they escape detection and the line appears to be a doublet, which is just what McLennan observed

In order to see the full structure of the lines, it is necessary to work with a resolving power of at least 500,000, this I achieved by using a reflecting echelon grating with a resolving power of about 800,000 and a light source which operated at the very low temperature of about 80° C With any less adequate means it is quite impossible to observe the smaller separations

D A JACKSON

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[1] *Proc Roy Soc*, A, vol 121 1928
[2] *Zeit fur Phys*, vol 67 1931
[3] *Proc Roy Soc*, A, vol 128, 1930
[4] *Zeit für Phys*, vol 47, p 176, 1923
[5] *Proc Roy Soc*, A, vol 128, 1930

Effect of Fungi upon the Strength of Timber

THE fact that fungal decay considerably lowers the strength of timber has long been familiar to all who employ this material for structural purposes, but practically no information has been available as to the actual amount of damage caused in any specific wood at various stages of decay Recently it has been shown that almost imperceptible decay may render Sitka spruce timber unsuitable for use where high mechanical strength is required An investigation carried out at Princes Risborough by the Forest Products Research Laboratory of the Department of Scientific and Industrial Research has now taken the matter a step further The rate of loss of mechanical strength in pieces of timber exposed to the attack of a fungus growing in pure culture, with the chemical and other changes taking place in the wood, have been accurately followed

The timber used in these experiments was Sitka spruce, one which is unusually homogeneous and therefore suitable for the mechanical testing and analysis of small samples, it is also a wood frequently used in structures such as aeroplanes where any deterioration of its strength may be a serious matter Previous work at the Laboratory has shown that this timber in certain circumstances is very susceptible to decay, and the fungus *Trametes serialis*, chiefly responsible for the development of brashness in it, has been studied.[1]

A large number of small, carefully selected test pieces were inoculated with cultures of *Trametes serialis* actively growing upon agar medium in culture flasks in which a high humidity was maintained

A number of test pieces were removed from the cultures after periods of exposure to the fungus varying from one to ten weeks, and tested for strength upon apparatus specially designed for the purpose; while at the same time matched control pieces, which had been kept sterile, were tested The progressive loss in weight and chemical change by the fungus were also determined, and these results were correlated with the strength figures Sections were cut from certain of the test pieces and examined microscopically.

Two sets of experiments were carried out and the results will shortly be published as a Forest Products Research Bulletin In each series there was an extremely rapid fall in the strength values, after only two weeks in the second experiment the average value for the strength of the pieces had fallen to about 80 per cent of that of the normal sound pieces, and afterwards the mechanical strength continued to fall rapidly until after ten weeks less than 20 per cent remained

This loss in strength could be closely correlated with the chemical changes brought about by the fungus The curve for the change in alkali solubility 'shadowed' quite closely the curve for the strength values It is of interest, however, to note that loss in weight of the specimens did not become significant until several weeks after the strength of the timber had begun to fall The increase in alkali solubility of the wood substance preceded the loss in weight caused by the respiration of the fungus

Examination of the sections of the test pieces showed that the hyphæ of the fungus rapidly permeated the blocks and penetrated the cell walls, but the amount of mechanical damage caused by the formation of small bore holes could not be considered as the chief factor responsible for lowering the strength of the wood, which should rather be looked for in the chemical changes in the material of the cell walls brought about by the fungus

W P K FINDLAY

Forest Products Research Laboratory,
Princes Risborough, Bucks,
May 18

[1] *Forest Products Research Bulletin* 4 K St G Cartwright. 'A Decay of Sitka Spruce caused by *Trametes serialis*" (London H.M Stationery Office)

An Unusual Solar Halo Complex

AN unusual halo complex was observed at Saskatoon, Canada, on April 16 between 8 20 A M and 9 15 A M, 105th meridian time Its appearance when the altitude of the sun was about 35° is shown in the accompanying diagram (Fig 1) The significance of the various letters is as follows *HH*, horizon, *Z*, zenith, *S*, sun, *aa*, halo of 22°, *ee'*, parhelia of the halo of 22°, *cc*, *c'*, upper and lower tangent arcs of the halo of 22°, *bbb*, portions of the halo of 46°, *d*, arc tangent to the halo of 46°, *mm*, parhelic circle, *pp'*, parhelia of 90°, *tt'*, parhelia of 120°, *h*, anthelion, *ss'*, narrow angle oblique arcs of the anthelion, *rr'*, apparently portions of wide angle oblique arcs of the anthelion, *gg'*, apparently secondary parhelia of the parhelia of 22°, *f*, arc vertically above, and concave towards the sun Coloured halos and arcs are shown by a solid and a dotted line, the latter indicating the blue side of the halo

Features which are worth noting in this halo complex are (1) the colour of the oblique arcs *r*, *r'*, and (2) the arcs *f* and *d* When the arcs *r*, *r'* were observed first they were so faint that it was impossible to be certain of their colour, but shortly before the disappearance of the halo they brightened to such an extent that the red colour on the side next the horizon was very noticeable The ends of the arc *f* appeared to merge into the upper horizontal arc *cc*, and the region enclosed by the two was much brighter than

the surrounding sky This arc appeared to have its centre at the sun, and was separated from the halo of 22° by an angular distance of about 3° Its position with respect to the halo of 22° did not appear to change with time, although the intensity of the light from it decreased more quickly then than that from other parts of the halo The arc *d* was not noticed

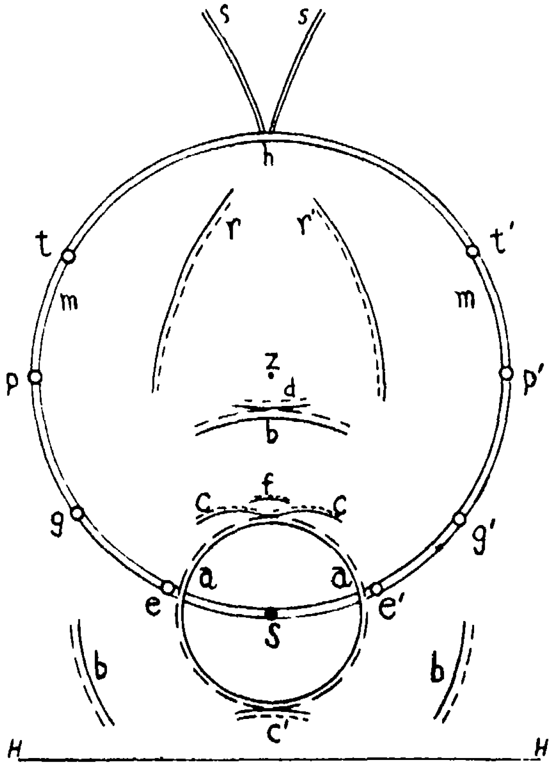

FIG 1

until several minutes before the disappearance of the halo, when it appeared as a short, brightly coloured arc, curved towards the zenith

Although halos are an infrequent occurrence in western Canada, halos of varying degrees of complexity were seen almost daily during the second and third weeks of April During this period of time there were two large dust storms, and it is suggested that small dust particles, carried to the level of the cirrus clouds, may have served as nuclei for the formation of ice crystals

B W CURRIE

University of Saskatchewan
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Arabic Source of Zadith's "Tabula Chemica"

THE basal texts of the alchemical knowledge of the Middle Ages in Europe are the "Turba Philosophorum" and the "Tabula Chemica" of Senior Zadith, son of Hamuel, but although both of them are obviously derived from Arabic sources, the latter have not hitherto been traced Some twenty-five years ago an Arabic manuscript containing three of the works—two in verse and the other in prose—of the tenth century alchemist Muhammad bin Umail came into our possession from Lucknow, and the work in prose, entitled "Al-Mā'al Waraqī wa-l Arḍ an-Najmīyah" ("Silvery Water and Starry Earth"), was cursorily examined, as—being largely a compendium of quotations from older alchemical writers—it seemed likely to throw some light on a similar work (the "Shawāhid") of the well-known authority on alchemy, Muhammad bin Zakarīya ar-Rāzī, who died in A D 925 As, however, no connexion could at the time be established between the two works, and the Indian text was somewhat defective, the manuscript was put on one side until its collation with other manuscripts of the same work could be made

This was not found possible until 1926, when the grant of a research scholarship by the Government of Bengal to Maulvi Turāb 'Alī enabled the work of collating the Indian text with photostat copies of two other manuscripts—one at Paris and the other at Leningrad—to be taken up It was then noticed by one of us (H E S, while on leave in England in 1927) that the contents of the "Mā'al-Waraqī" were very similar to the treatise of Senior Zadith, and comparison of the Latin text in vol vi of Zetzner's "Theatrum Chemicum" (Strasbourg, 1659) showed not only the identity of the two texts, Latin and the first half of the Arabic, but also that both were a commentary on one of the poems contained in the Lucknow manuscript, and, partially, also in the treatise of Senior The name of this poem is "Risālatu sh Shams ila l-Hilāli", which appears in the Latin under the literal translation "Epistola Solis ad Lunam Crescentem" A portion of the Latin translation of the "Mā'al Waraqī" was also found to be included in the compendium of alchemical treatises known as "Artis Auriferæ quam chemiam vocant" (1593 ed, pp 246-256) under the incorrect title "Rosinus ad Euthiciam" This last named volume includes two versions of the "Turba Philosophorum", and it was next noticed that the latter work includes at least three passages that are to be found in the "Mā'al Waraqī" Finally it was discovered that not only had the author of the "Mā'al Waraqī" drawn some of his materials from both Ar Rāzī's "Shawāhid" and another treatise by Ar-Rāzī's immediate predecessor, Mahrārīs, but also that the fourteenth century treatise of the Arabic alchemist al 'Irāqī, "Kitāb al 'Ilm al Muktasab fī Zira'at adh-Dhahab" (edited and translated by Dr E J Holmyard in 1923), was largely based on the "Mā'al Waraqī"

A paper on the subject (which will include both Maulvi Turāb 'Alī's recension of the Arabic text as well as an edition of Senior Zadith's "Tabula Chemica") is now being published in the *Memoirs of the Asiatic Society of Bengal*, and an account of the recent discoveries, which throw much light on the history of chemistry, will be given at the Second International Congress of the History of Science and Technology that will be held at South Kensington at the end of June

H E STAPLETON

Writers' Buildings, Calcutta

M HIDAYAT HUSAIN

Calcutta Madrasah,
April 14

Two Modifications of Liquid Carbon Disulphide

THE data of H Isnardi [1] show that the dielectric constant of carbon disulphide undergoes at the temperature of − 90° C. a sudden change This phenomenon appears at a considerably higher temperature than the freezing point of carbon disulphide (− 112°), it is thus similar to ethyl ether On the basis of our work on ethyl ether we may therefore suppose that the carbon disulphide undergoes at − 90° C a transformation from one liquid modification into another one

To confirm this assumption, we have made a study

of the heating curve of carefully chemically purified carbon disulphide The apparatus used in this study was the same as that used previously for ethyl ether and nitrobenzene [2] Carbon disulphide was cooled to a temperature − 93°, we then observed the change with time of the gradually increasing temperature of the substance, which was isolated from all external thermic influences The observations of temperature were made in intervals of 10 sec The observations, repeated five times, have shown that at − 90 03° there appears a distinct break on the heating curve (see the part *AB* of the curve on the accompanying graph, Fig 1) Both parts of the curve, above and below *AB*, are to a high degree of approximation straight lines, making appreciably equal angles with the axis of time This shows that the specific heat of carbon disulphide does not undergo an appreciable change

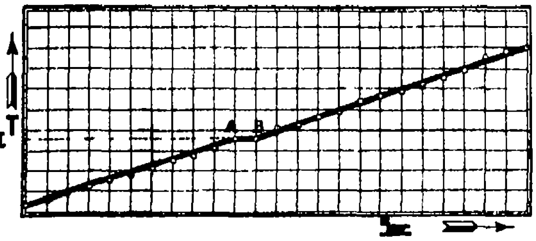

FIG 1

at the transformation point Measurement of the value of the refractive index as a function of temperature shows also a break at this point

It should be mentioned that the existence of two different liquid modifications of carbon disulphide could be distinctly observed during the cooling of the substance, because the two modifications do not mix together and so a sharp dividing line can be seen This dividing line between the two liquid modifications can also be sharply seen during the slow heating of carbon disulphide This phenomenon depends, of course, on the sharp change of the refractive index

The heat of transformation, estimated roughly from the heating curve, is for carbon disulphide about 0 04 cal /gr, for ethyl ether 0 07 cal /gr, for nitrobenzene 0 14 cal /gr All these values are of the order of the heat of transformation of helium I into helium II [3]

The phenomenon reported in the present communication is the third case observed by us of the existence of two different liquid modifications of an organic substance

M WOLFKE
J MAZUR

Physical Laboratory, Technical Institute,
Warsaw, April 19

[1] *Zeit für Phys*, 9 153 1922
[2] M Wolfke and J Mazur, NATURE, 126, 684 1930
[3] M Wolfke and W H Keesom, *Comm Leiden*, No 190b

Bridges' Genic Balance Theory of Sex Determination

IN Bridges' table of sex indices,[1] in connexion with balanced intersexuality in *Drosophila*, the fact that the female intersex is a triplo IV and the male intersex a diplo IV is not expressed The chromosomal difference between the two is not allowed for in the calculation of the series of sex indices Since the addition of a IV chromosome to the male intersex chromosome relation converts it into a female intersex, the "IV chromosome must have a net female tendency similar to that of the *X* and different from that of the other autosomes" The following modification is, therefore, suggested

X and IV represent the totality of female determining genes

II and III represent the totality of male determining genes

The addition of one IV chromosome to the chromosomal complex of the *male intersex* converts it into a *female intersex* On the other hand, the addition of an *X* chromosome to the male complex converts the *male* into a *female* The efficiency of the female determining genes on the IV chromosome must consequently be very much less than those on the *X* chromosome

Assigning arbitrary values to the efficiencies of the two interacting components, male on the autosomes II and III, and female on chromosomes *X* and IV, the subjoined series of sex indices is obtained

Let the efficiency of the female determining genes on the *X* chromosome be represented by $100 = f$, that on the IV chromosome by $10 = f'$, and the efficiency of the male determining genes on II and III chromosomes be represented by $100 = M$

Chromosome Relation	Gene determining Relation	Sex Type	Sex Index
3X 2A	$3f+2f'$ $2M$	super female	1 60
4X 4A	$4f+4f'$ $4M$	4N female	1 10
3X 3A	$3f+3f$ $3M$	3N female	1 10
2X 2A	$2f+2f'$ $2M$	2N female	1 10
1X 1A	$1f+1f'$ $1M$	1N female	1 10
2X 3A	$2f+3f'$ $3M$	female intersex	0 77
2X 3A (−IV)	$2f+2f'$ $3M$	male intersex	0 73
1X 2A	$f+2f$ $2M$	male	0 60
1X 3A	$f+3f'$ $3M$	super male	0 43

This table represents more accurately the genotypic differences of the various sex types, more especially the difference between the male and female intersexes, and can be applied to Bridges' suggestion that "by variation in the number of IV chromosomes, it is possible to have a fringe of minor sex types about each of the major types of sex difference"

H ZWARENSTEIN

Department of Physiology,
University of Cape Town

[1] Bridges, C B, *Amer Nat*, 59, 127 1925

Forestry Research in Great Britain

THE correspondence in NATURE and the leading article on "Forestry Research in Great Britain" in the issue for May 16 lay stress on certain points which need to be emphasised It appears, however, that an even wider view of the problems must be taken if we are to make the most of our opportunities and of our obligations Every schoolboy knows about the struggle for existence, the survival of the fittest, and similar phrases, but it is rare to meet a forester who has been trained to pay attention to the analysis of the factors as they occur either in natural woodlands or in plantations This is not surprising, for intensive research in fundamental problems has been almost completely neglected in Great Britain

Some attention has been paid to a few obvious diseases, but the results are almost negligible compared with what is known about fungal attack when timber has been worked, though these are often part of the same problems and should be treated as such

The fungus root (mycorrhiza) of trees is equally a subject which should be investigated seriously Little or nothing has been done in Britain, and no one has been wholly engaged in its study It does not seem

to have been realised generally that casual identifications of woodland fungi presumed to be operative are worthless, and moreover, that these fungi when they are not concerned with mycorrhizal roots have, nevertheless, an influence on the fertility of the soil, for the mycelium ramifies amongst leaves and obtains its nutriment from them

The work that other fungi accomplish in the soil is also a matter for research, it is certain that they are as important as bacteria, but I know of no work on them here or elsewhere

The conditions overseas in natural forests are disturbing, when one considers both exploitation and replanting On the last visit of the British Association to Africa I was told that it was of no use my going to a certain forest if I wanted to collect fungi, I was repaid for my scepticism by the two best collecting days in twenty years' experience

I have directed attention to the major activities of a single group of organisms, but even less is known about the more indirect ones of other cryptogams We need still to keep cats and clover in mind

With so many research problems crying out for attention, and the Breckland area within easy distance, it would seem that the Cambridge Forestry School might be saved from the fate which threatens it

We have followed the German school more or less blindly and we should be unwise now merely to follow the Swedish school Darwin first clearly pointed out the interplay between different organisms, and this principle applied with modern ecological methods of research would lead to the practical results by which the forester must, in the end, judge them

J Ramsbottom

British Museum (Natural History)

The Low Altitude Aurora of Nov 16, 1929

In Nature of May 2, p. 663, Dr G C Simpson has compared the observation of an aurora in Abisko on Nov 16, 1929, mentioned by me in Nature of April 11, 1931, with an observation of an aurora made by him twenty seven years ago After a description of the last mentioned aurora, he arrives at the following conclusion "It is clear that these two experiences were practically identical, and there can be little doubt that what Mr Corlin considered to be the thicker parts in the cloud covering were really breaks in the cloud through which the dark sky could be seen"

There are, however, two important differences in the observations mentioned, which show that this conclusion cannot be valid, namely—(1) during the observation at Abisko the *cloudy structure* of both the thinner and the thicker strata could be easily seen, so that there is no doubt at all that they were clouds and not "the dark sky" in addition, some few real breaks in the clouds elsewhere showed that the uncovered sky was light blue owing to the moonshine, (2) the auroral ray observed at Abisko was apparently equally intense in front of both the thinner and the thicker strata with rather sharp limits, whereas the aurora observed by Dr Simpson showed "bright and dark patches owing to the clouds" Therefore the auroral ray at Abisko on Nov 16, 1929, was either in front of the clouds or was far above the clouds, but had a greater intensity than the full moon

Auroræ brighter than the full moon may possibly occur on rare occasions An extremely bright aurora of possibly so high intensity was, for example, observed on Jan 5, 1930, 3h 30m G M T, by the caretaker of the tourist station at Abisko, who awoke from his sleep and first thought that the tourist station was burning, but found that an aurora of extraordinary intensity was flashing all over the sky. Therefore, I have not been 'convinced' that the auroral ray on Nov. 16, 1929, was really below the clouds, but after reading later Mr Cummings's observation of a low altitude aurora in Norwood, Canada, *on the same day* (Nature, Jan 17, 1931), I now find it more probable that a low altitude aurora (being thus a planetary phenomenon) really occurred on that day both at Abisko and at Norwood than that we should have by chance the same curious 'illusion' on the same day at places so far apart

Axel Corlin.

The Observatory, Lund,
May 23

The Inheritance by a Leafhopper of the Ability to Transmit a Plant Virus

Leafhoppers of the species *Cicadulina* (*Balclutha*) *mbila* Naude, after feeding upon a maize plant affected with the virus disease known as 'streak', will usually transfer this disease to all healthy maize plants upon which they may subsequently feed In the course of studies of the virus transmission by this species of insect, however, I have frequently encountered individuals which failed to transfer the virus under conditions normally favourable to this process Repeated tests of these individuals, after further periods of feeding upon diseased plants, led me to believe that they were incapable under the experimental conditions, of acting as vectors of this virus

I have recently studied the inheritance by this insect of the ability to transmit the streak virus by breeding successive generations from parents selected for this character In this way I have obtained races which breed true for the character selected Thus certain races, which may conveniently be called the 'active' races, consist of hoppers, every individual of which will invariably transfer the streak virus under suitable conditions On the other hand, 'inactive' races have been raised in which every individual is incapable of transferring the virus I have failed to find any morphological difference between the hoppers of these several races

In the course of this pure line breeding it became clear that the character of 'activity' behaved in inheritance as dominant to the character of 'inactivity' Later study of crosses between the two pure-breeding races confirmed this conclusion and, furthermore, showed that the character was linked with sex Thus the cross, active ♂ × inactive ♀, gave an F_1 progeny of inactive ♂♂ and active ♀♀ In the F_2 generation, active and inactive hoppers appeared in approximately equal numbers in each sex The reciprocal cross, inactive ♂ × active ♀, gave an entirely active F_1 offspring, and segregation in the F_2 generation into active and inactive ♂♂ in approximately equal numbers, and only active ♀♀

These results conform with the well-known *Drosophila* type of sex-linked inheritance

H H Storey

East African Agricultural Research Station,
Amani, Tanganyika Territory,
April 22

Molecular Combination of Aliphatic Iodides.

The binary system hexadecyl iodide (m p 23 3°)–octadecyl iodide (m p 32 9°) has a eutectic point (19 3°) and a non-congruent melting point (22 3°), showing the existence of a compound of one molecule of each iodide This appears to be the first example of combination of alkyl halides

J C. Smith.

The Dyson Perrins Laboratory,
University of Oxford,
June 9.

Fourth Centenary of the Collège de France.

AMONG the great educational institutions of Paris the Collège de France, founded by Francis I in 1530 as the Collège Royal, is one of the oldest and most famous, and this week (June 18–20) is celebrating the four hundredth anniversary of its foundation The celebrations commenced with receptions in the Collège itself and at the Hôtel de Ville, on June 19 there was a gathering in the great amphitheatre of the Sorbonne, presided over by the President of the Republic, and on June 20 a visit is to be paid to the château of Francis I at Fontainebleau, and a gala performance will take place at the Théâtre Français During the forenoons of June 18 and 19 there are to be conferences in the Collège de France, when discourses on the development of the various sciences are being delivered by MM Sylvain Lévi, H Vincent, Paul Langevin, and Edmond Faral, while in the Bibliothèque Nationale an exhibition has been arranged recalling the work of the men who have added lustre to the name of the Collège

Francis I has been described as a prince of excellent abilities, kindly disposition, rash and generous, but licentious and without principles Like many others, his reign, which began in 1515 and ended in 1547, was marked by long wars and much persecution Yet it was also marked by an increasing interest in literature and art, and Francis is remembered as the protector of Rabelais, the patron of Leonardo da Vinci, and the friend of Erasmus His age was that of the Reformation, the age of Luther and Calvin, which was likewise the age of Michelangelo, of Durer, of Copernicus, of Vesalius, of Paracelsus, and of Georg Agricola The sack of Constantinople in 1453 had made the treasures of the ancient world available for all mankind, learning in all its branches had received new impetus, and the founding by Francis I of the Collège de France was but one outcome of a momentous movement Inaugurated under the most promising auspices, free from clerical restraint, and devoted to all branches of knowledge, the Collège, like many similar institutions, has passed through periods of stagnation, and at one time its chairs were bestowed by ministers on their family doctors or tutors to serve as pensions, but during the later part of the eighteenth century it was reconstituted, and it has ever since played a conspicuous part in the intellectual life of Paris When founded in 1530 the lectures were given in different colleges, but the present building near the Sorbonne was commenced in 1610 and was completed about 1778 Bearing over its doorway the inscription *Docet Omnia*, the Collège to day possesses more than forty chairs, and all its lectures are public and free

Not the least interesting feature of the Collège is its collection of busts and memorials which help to recall its history Though some of its professors have left behind them little but their names, there have been many who by their writings, their discourses, their researches or discoveries, have added vastly to the spread and increase of knowledge The first professor of mathematics, chosen by Francis himself, was Oronce Fine (1494–1555), the author of thirty one works and the constructor of models which were still in existence at the time of the Revolution Another mathematician was a far more famous man, Pierre de la Ramee (1515–1572), better known as Ramus, who fell a victim to the massacre of St Bartholomew His works on arithmetic, geometry, and algebra were the standard text-books, and he was as distinguished as a philosopher as he was as a mathematician Among his pupils was the almost forgotten Jean Pena, who translated Euclid's "Catoptrica", but who died at the age of thirty Roberval (1602–1675), the opponent of some of the views of Descartes and the supporter of those of Copernicus, became professor of mathematics in the college in 1632, and in 1645 Gassendi (1592–1655) was made one of his colleagues Picard (1620–1683), the astronomer, was first the assistant and then the successor of Gassendi, while a successor of Roberval's was La Hire (1640 1718) To Picard and La Hire belongs the credit of being the first to use the newly built Paris observatory for regular observations, and together they were employed by Colbert on the construction of a map of France Duhamel (1624 1706), the first secretary to the Academy of Sciences, Sauveur (1653–1716), the partly deaf founder of the science of acoustics, and the mathematician Varignon (1654 1732), whose "Projet d'une nouvelle mécanique" appeared the same year as Newton's Principia", were all associated with the Collège at the end of the seventeenth or the beginning of the eighteenth century

It was soon after this that the fortunes of the Collège sank to their lowest ebb, when no one spoke of it, and its posts were bestowed as pensions Under Louis XV the tide turned, orders were issued for its reorganisation, and through Delisle, Lalande, and others its halls again became a centre of attraction Delisle (1688–1768), the friend of Newton and Halley, had spent twenty years in Russia before he became a professor at the Collège de France, and Lalande (1732–1807), his successor, had likewise spent a short time at Berlin As anxious to call public attention to himself as to astronomy, Lalande became the most popular exponent of science of his day, and he stands in the first rank as a professor and a writer Succeeding Delisle in 1762, he held a chair at the Collège de France for nearly forty six years One of Lalande's best known contemporaries was Darcet (1725–1801), a chemist known for his study of the manufacture of pottery With Monge he was one of the earliest explorers of the Pyrenees, and his lecture in 1775 on his experiences was the first ever delivered at the Collège of Science in the French instead of the Latin language

Surviving the Revolution almost unchanged, the Collège de France, under the Napoleonic era, like the Institut, the École Polytechnique, the École Normale, and the Jardin des Plantes, became one of the scenes of the activities of the brilliant group

of men of science which made that era so memorable in the history of science Never before or since, perhaps, has there been gathered together in one city so many of the world's greatest contributors to the advancement of knowledge as there were in Paris at the beginning of the nineteenth century, and it was but natural that the Collège de France, with its unfettered regime and its public lectureships, should become one of the homes of those who spoke with authority One eminent man who held office during the Revolution was Daubenton (1716–1800), the collaborator of Buffon When he died, his chair passed to none other than Cuvier (1769–1832), the founder of palæontology and comparative anatomy, whose last lecture was given in the Collège only a few days before he died Contemporary with Daubenton and Cuvier were the chemist Vauquelin (1763–1829), the discoverer of chromium, Thenard (1777–1857), in whose favour Vauquelin resigned in 1804, and Biot (1774–1862), who in 1800, at the age of twenty-six, was appointed professor of natural philosophy

No less distinguished were the successors of these famous men In the realm of physiology there are few names better known than those of Magendie and Bernard Magendie (1783–1855), who described himself as a "rag picker of facts", and on his death bed remarked to a friend, "You see me here completing my experiments", became a professor in 1831, the year he visited Sunderland to study cholera To him in 1847 as an assistant came Claude Bernard (1813–1878) who succeeded to Magendie's chair in 1855 Bernard's life as a Master of Medicine was written by Sir Michael Foster To the chair of experimental physics at the college in 1824 was appointed Ampère (1775–1836), the centenary of whose publication of the fundamental laws of electro-magnetism was celebrated at the Sorbonne ten years ago, and at his death, Savart (1791–1841), who for eight years had been curator of the physical cabinet, succeeded him Savart in turn was followed by Regnault (1810–1878), who, like Faraday, after having obtained a reputation as a chemist, turned physicist Regnault in 1854 was made director of the Porcelain Factory at Sèvres, and it was there, and not at the Collège de France, that his apparatus for the investigation of the expansion of gases was destroyed during the German occupation of 1870 Two years after this Regnault resigned his position at the Collège de France, and his chair passed to his deputy Mascart (1837–1908), afterwards destined to be director of the Central Bureau of Meteorology and president of the Paris Academy of Sciences What Biot and Ampère and their successors did for physics was paralleled by the work of the eminent chemists who followed in the chairs of Darcet and Vauquelin Pelouze (1807–1867), the successor of Dumas at the École Polytechnique, lectured for many years at the Collège de France, and in 1850 was succeeded by Balard (1802–1876), who had achieved fame at the age of twenty four by his discovery of the element bromine Balard was closely associated with many notable men of science He owed much to Gay Lussac, it was in Balard's laboratory, at the École Normale, Pasteur in 1848 made his remarkable discovery with tartaric acid, to him in 1837 as an assistant came Berthelot, while his assistant in later years, Schutzenberger (1829–1897), in 1876 became his successor Almost the whole career of Berthelot was bound up with the Collège de France, where in 1865 a chair of organic chemistry was created for him When he died forty two years later it was said that France had lost her most eminent man of science No one ever associated with the historic Collège was more convinced of the moral and practical value of scientific inquiry, and he once wrote "La Science domine tout"

Induced Malaria.

It is well known that, for some time past, malaria has been purposely induced as a remedial measure in persons suffering from general paralysis of the insane The therapeutic value of this proceeding has been placed beyond doubt Up to 1928, of 2499 patients in institutions in England and Wales so treated, 1188, or 47 5 per cent, were benefited sufficiently to be recorded as 'recovered', 'much improved', or 'improved' Of 656 cases in 1929, 47 7 per cent came under the same heading The 'discharged recovered' numbered nearly 12 per cent, and the 'discharged relieved' six or seven per cent Thus nearly one fifth of the cases treated by artificial infection with malaria benefit sufficiently to be discharged from hospital

From a medical and a moral point of view, therefore, there is abundant justification for subjecting sufferers from one malady, grave and intractable, to the risks attendant upon infection with another which is controllable by drugs At the same time, it has become apparent that the procedure affords a unique opportunity for the clinical study of malaria itself, a disease incomparably more important than general paralysis of the insane as a world problem, and one which is still beset by questions scarcely answerable in the uncontrolled conditions of the field

Arrangements were therefore made at the suggestion of Col S P James, adviser on tropical diseases to the Ministry of Health, whereby the Ministry, in consultation with the Board of Control, the London County Council, and Col J R Lord of Horton Mental Hospital, Epsom, organised what is virtually a first essay in clinical investigation under strictly experimental conditions Colonel James communicated a report on the first results to the Malaria Commission of the League of Nations in 1926, and communicates a record of the material which has since accumulated to the *Transactions* of the Royal Society of Tropical Medicine and Hygiene (**24**, 5, 477-538, March 1931)

It is very difficult to find malaria patients who can infect *Anopheles maculipennis* Of 305 mosquitoes dissected when sporozoites should have

been present in the salivary glands, ten only were found with zygotes in the stomach and none with sporozoites in the glands They were among eight batches fed, some of them as many as five times, upon the blood of patients with a high gametocyte count Dr P A Buxton suggests that a gelatinous sleeve, such as Schaudinn has described (perhaps present only at a certain phase in the process of digestion), arises from the chitogenous cells of the fore-gut and intervenes between the blood and the epithelium of the mid gut of the insect, thus accounting anatomically for the heavy infection of some *maculipennis* and not of others While the problem of insect infection needs further study, it has been ascertained that the condition of the gametocytes of *P vivax* in the blood of patients who are 'good infectors of *Anopheles*' is such that the male forms of the parasite in thin blood films kept moist at 25° C 'exflagellate' within fifteen minutes With *P falciparum* and *P malariae*, even this indication of infectability for *Anopheles maculipennis* is uncertain There are good and bad receptors of infection as well as good and bad infectors But there is no positive evidence that a particular species of *Anopheles* is a better 'malaria carrier' than another

If susceptible patients are bitten by mosquitoes which have sporozoites in their salivary glands, infection does not always result This may be accounted for by non injection of sporozoites Excluding such cases and also cases in which there was doubt whether or not the patient had suffered from malaria previously, 18 per cent of the number of patients who certainly received sporozoites failed to develop malaria within the usual incubation period These are held not to be attributable to the presence of 'immune bodies' in the patients' blood Some are examples of 'latent infection', others may be due to an anaemic or otherwise abnormal physiological condition of the blood

Failure may also result from the fact of a previous attack, and some of Col James's most suggestive results concern the course of malaria in cases treated by quinine In cases of so-called 'spontaneous recovery' from benign tertian malaria the infection 'smoulders', and the blood picture and parasite findings assume features akin to those of the blood of native children in hyperendemic areas Usually, between the eighth and tenth months after primary infection, there is a definite recurrence of fever and a reappearance of parasites in the blood, followed in a few days by recovery A few small doses of quinine then secure freedom from further attacks and from parasites Before the recurrence, the patient can be reinfected with the same parasite, but after 'spontaneous recovery' such patients are proof against reinfection This condition of immunity is inhibited by quinine therapy On the other hand, immunity to reinfection by *P vivax* confers no protection against *P falciparum* or *P malariae*, and complete immunity to reinfection by one strain of *P vivax* confers at best only a partial protection against another strain As immunity has hitherto been studied only as a mass problem among natives races, Col James suggests that the development of these findings should be carried out by field workers

Cases are recorded in which the expected malarial attack was six months or more late Since infection is desired early in malaria therapy, such cases are rare in induced malaria, but it has been possible to study twelve in which from 28 to 45 weeks intervened between infection and attack In one of these the patient had been infected with quartan fever when, nine months after infection with tertian, the benign type developed unaffected by a long attack of quartan followed by a curative course of quinine

If a distinction is made between the return of fever within eight weeks of recovery from a primary attack (recrudescence) the return between 8 and 24 weeks (relapse) and the return later than 24 weeks (recurrence), about half the patients infected by mosquito bite have one or other of these manifestations, the other half none Recurrence was found to occur within 27 to 39 weeks of primary infection, and all of the cases which 'recurred' in the twenty seventh week became ill on the 190th to 194th day after their blood became free from parasites after their primary attack This relationship led the investigators to construct a graph representing the history of 107 cases referred to the same starting-point The resemblance between this graph and representations of the seasonal clinical incidence of benign tertian malaria in northern Europe suggests that the 'spring rise', about which so much has been written, is due not to any climatic circumstance but to recurrences in persons who had their primary attack in September, with primary attacks in persons whose infection in September remained latent throughout the winter

Observations on prophylaxis by quinine support those made by Yorke and Macfie Quinine taken prophylactically will not prevent infection, but this is different from saying that it will not prevent clinical attacks Whether persons who have to live in a malarious place would be better advised not to take a daily dose of quinine but to wait until they get a true malarial attack which would be adequately treated by quinine, or whether they would be better advised to take a daily dose suppressing the outward clinical manifestations of the disease in order to 'carry on' during periods of moderate fever and indisposition, are questions to be answered differently in different cases The daily dose taker gains little or no immunity, and a period of exceptionally hard work is likely to determine a more severe attack than he usually suffers Large doses (30 gr) of quinine given at any time during the incubation period have no effect, a single dose of 5 gr after five or six paroxysms stops the fever but permits a recrudescence within a fortnight, a small dose (5 gr) given later and repeated daily for a few days cures 50 per cent of cases Existing practice would be revolutionised by adopting the indications afforded by these facts, but it would be unjustifiable to withhold quinine in a case of malignant tertian malaria later than the first discovery of parasites in the blood

Obituary

PROF W D HALLIBURTON, F R S

IN a nursing home at Exeter, William Dobinson Halliburton passed away, peacefully, on the evening of May 21 With his death the physiological world loses one of its most outstanding personalities, King's College one of its most loyal friends, and those who knew him, one who occupied, in their affection, a place it will not be possible to fill For Halliburton was unique To many is given knowledge, to many also the power to impart it A few have the intuitive faculty of investigating the fundamentals of their subject and of guiding the steps of others in the uncharted pathways of original research How restricted is the number who combine these attributes with patience apparently unlimited, calmness in times of stress, encouragement when disappointments came, and never, by word or deed, acted other than in the spirit of reasonableness Yet such was Halliburton

Born in London seventy years ago, educated at University College School, trained under distinguished teachers at University College and Vienna, Halliburton graduated in medicine and became Sharpey scholar and assistant in the Department of Physiology under Prof [now Sir Edward Sharpey] Schafer, following in this position MacWilliam, who until recently held the chair of physiology at Aberdeen Further academic attainments followed, he obtained his M D in 1884 and his membership of the Royal College of Physicians twelve months later

It was, however, four years after this that Halliburton's life-work began, for in 1889 he was elected to the chair of physiology at King's College, London, rendered vacant through the retirement of Prof G F Yeo, an appointment he held until his illness at Christmas 1922, an illness which, unfortunately, caused him to relinquish his professorship in the following July Since then his physical vigour has gradually failed and, while on holiday in his favourite Cornwall, a sudden relapse demanded his removal to Exeter, where he died

The present Department of Physiology at King's College is a tribute to the organising ability of Prof Halliburton On taking up his duties, he found the physiological laboratory situated in ill adapted premises in the basement But it was there, though handicapped in many ways, that some of his finest work commenced, and shortly after his appointment a move was made to the present position, where under his guidance it grew and prospered It was a source of gratification to him and to others that five years after his retirement, he was able to open extensions to his old department, extensions for which he had hoped and worked and, by his labours, justified

In his choice of staff and colleagues in research, Halliburton was singularly happy—one has but to name Dr [now Sir Charles] Martin, Sir Frederick Mott, T G Brodie, F S Locke, and Otto Rosenheim

Despite excursions into other parts of physiology, it was the chemical side to which Halliburton always returned, devoting much attention to the problems connected with the properties of nerve, of muscle, and of protein As an investigator his name is perpetuated in the pioneer work in these questions Halliburton made physiological chemistry his own It is largely to him that the present position of biochemistry is due By his earlier work and by his writings he laid the firm foundations of his subject, and his researches are now part of the heritage of physiology

Handicapped as he was in personal experimental work, his capacity for compiling and classifying information was little short of marvellous His "Text Book of Chemical Physiology and Pathology" (1891) is monumental, his "Handbook of Physiology" has completed nineteen editions, his "Essentials of Chemical Physiology" is now in its fourteenth In addition to these labours, at the request of the Physiological Society he became, in 1916, editor of *Physiological Abstracts*, a task which involved the issuing of a monthly précis of papers on biological subjects appearing throughout the world Almost unaided for five years, he not only edited and managed this journal, but also did the major part of the abstracting Other publications include "The Chemical Side of Nervous Activity" (Croonian Lectures, 1901), "The Biochemistry of Muscle and Nerve" (1904), "Physiology and National Needs" (1919) As contributions to original work, there appeared from his laboratory some three hundred papers by himself and by others He delivered the Oliver Sharpey (1907), the Goulstonian (1893), and the Croonian (1901) Lectures of the Royal College of Physicians He commenced and for several years compiled the invaluable section of physiological chemistry in the "Annual Reports on the Progress of Chemistry"

In 1891 Halliburton was elected a fellow of the Royal Society the degree of LL D was conferred on him by the Universities of Aberdeen and Toronto He was a fellow of both King's and University Colleges, senator of the University of London, member of the council of the Royal Society, and, in turn, vice president of the section of Anatomy and Physiology at the meeting of the British Medical Association in 1893 Twice, also, he was honoured by being president of Section I (Physiology) of the British Association

As a speaker Halliburton was supreme He brought to King's not only a scientific knowledge possessed by few, and a command of his subject coveted by many, but a facility of expression envied by all It was, indeed, a tragedy, in his later years of leisure, to see the gradual loss of this great gift

Halliburton's whole life reflected his personality Never physically strong, his ability to carry out the strenuous programmes that he did was due to the unflagging devotion of Mrs Halliburton, who until the end was untiring in her watchful care

(*Continued on p* 945)

Supplement to NATURE

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Habit The Driving Factor in Evolution *

By Prof E W MacBride, F R S

NO subject is of such perennial interest as evolution, for evolution means the gradual growth of one type of an organism into another as the generations succeed one another It is quite clear that if the possibility of this kind of growth be conceded for one type of organism it must hold good for all, since all, from the highest to the lowest, exhibit the same essential types of growth and reproduction Therefore the problem of evolution is the problem of the growth of all animated Nature, of which we ourselves form a part

One of the principal interests of zoology has been to endeavour to trace the course which evolution has actually pursued in the case of each particular group of animals It is as fascinating a problem as a cross word puzzle, with this great disadvantage, however, that it has been so far impossible to arrive at an agreement as to what is the correct solution

When this was first fully realised, interest in the problem dropped off In some quarters it was regarded as insoluble, and it was considered that the most contradictory solutions were equally likely Yet if the problem were given up, zoology would cease to be a science and be reduced to a lumber room of disconnected facts, as indeed was its condition during the eighteenth century

It is quite clear, however, that the problem of evolution is a secular one However it may have proceeded, its progress has been exceedingly slow and it is impossible to obtain direct evidence of the actual operation of an evolutionary process from observations made during the span of a human life Zoology shares this disability with geology, but geology is in better case than zoology, for geological structure, affecting as it does our obvious material surroundings, is likely to find a place in our permanent records, but no one in past ages is likely to have left minute descriptions of our common animals with which we might compare descriptions of their appearance to-day. All evidence for the occurrence of evolution is therefore indirect, for direct observation of living animals yields very little but confirmation of the old maxim that 'like begets like' Everything turns, therefore, on the validity and convincing power of this indirect evidence

The evidence chiefly relied on during the nineteenth century was similarity in ground plan of structure All animals possessing a back bone, for example, are built on the same general plan If all these animals had been evolved out of a common ancestor, this is what we should naturally expect to find, and these facts, although they do not prove evolution, are consonant with the theory that evolution has occurred Of course, if fish, amphibians reptiles, birds, and mammals all have grown out of one common stock, then the rule of 'like begets like' must have suffered exceptions, but this difficulty is got over by assuming a principle of 'variability', a principle which I shall discuss later

Further research into comparative anatomy has shown, however, that 'similarity in ground plan' does not always imply community of descent The muscles of fish and of the lower amphibia are divided into similar segments repeated in a line one behind the other, and so are the muscles of the common worms, but the view that worms and fish owe their similarities to descent from a common ancestor has now been given up by most zoologists It was, however, passionately advocated for at least a quarter of a century by the late Dr Dohrn, the founder of the Zoological Station at Naples Its disrepute is largely due to the assumptions which it involves if it be true, then worms must have given up their original mouth and invented a new one on the opposite side of the body in order to become vertebrates, and the main divergence between the supporters of this and rival theories of vertebrate descent depends on the view which their respective supporters take of the relative 'probability' that a new mouth would have been substituted for an old one, or that segmented muscles should have been evolved independently in two cases

* Royal Institution Discourse delivered on June 5

If variations occur sporadically in all directions 'by chance' for no assignable reason, if indeed, as the Bishop of Birmingham suggested in a recent address on "Heredity and Predestination", 'genes' come 'aus der Ewigkeit" and evolution depends on the chance correspondence of one of these genes with the needs of the animal, then the question of the acceptability of one theory of a particular descent over another is ultimately a question of the powers of imagination and credulity possessed by the theoriser

If, however, as most of us who have looked into the question agree, evolution, if it has occurred at all, has been slow, and structure has been modified in accordance with the demands of function, then we must look for evidence of a more satisfying kind than mere agreement in ground plan of structure So far as I can see there are three sources of evidence open to us, and only three We shall examine them briefly in turn

The First Proof of Evolution

(1) A species of animal is defined as an assemblage of individuals resembling each other closely, except so far as differences connected with age and sex are concerned, and crossing freely with one another and producing fertile offspring

Now if we examine wide ranging species the members of which do not wander about much, we find that all such species are divisible into local races, each race inhabiting a circumscribed area The members of each race differ from those of the next race in minute characters such as colour and the proportions of the limbs and trunk, etc No one has ever questioned the assumption that these various races have been evolved or developed out of a common stock, even the theological opponents of Darwin, who assumed that the Almighty had created every species independently, admitted this But subsequent research by naturalists has shown that there is no hard and fast line to be drawn between the differences that separate races and those that divide species There is, for example, a squirrel ranging all over tropical Africa known as *Heliosciurus* This varies a great deal in colour, and systematists had classified these colour varieties as distinct species But Mr M A C Hinton, after the examination of an enormous amount of material, has come to the conclusion that all these supposed species are merely local races of the same widely distributed species It is assumed, of course, that members of distinct species will rarely breed together, and that when they do so they produce infertile hybrids, but that when members of distinct races breed together they will produce numerous fertile offspring

In very few cases has this test been applied, however, we *guess* that two assemblages are distinct species, because when they come into contact with one another in Nature they keep distinct from one another, and in those cases where the experiment has been tried they are often mutually infertile But suppose we are dealing with two very similar groups of animals, one in Europe and one in America, and we regard each group as a distinct species, how shall we discover whether they are mutually fertile or not? In fact, it appears, especially from the researches of Dr Goldschmidt, who bred together members of the different geographical races of the Gipsy moth (*Lymantria dispar*), that there is no absolutely sharp division between sterility and fertility, but that there is every grade of fertility, with the zero limit at sterility

I have said that the division of the species into local races is only found in species which do not wander much Where there are extensive migrations either in search of food or to accustomed breeding places, members of the species drawn from all localities mingle together and no local races are formed Dr Johan Hjort has shown that an adult cod in the North Sea may travel as far as 2000 miles in one year to and from its breeding place No better example of the contrast between a stationary and a migratory species could be imagined than that between the so called viviparous eel, which is a blenny, and the true eel The true eel when fully grown is a fresh-water fish Its ally, the conger eel, haunts the sea, but is only found in shallow water close to the shore The true eel lives in rivers and ponds for several years, eating voraciously and growing enormously in size When fully grown, the desire to migrate to the sea overcomes it If it is in a river, it swims downwards to the mouth, if it is in a pond, it emerges at night and wriggles over the moist grass until it reaches the nearest stream and then resumes its journey to the sea I once surprised an eel in this migration, it was wallowing in a mud puddle in a field a few yards from the edge of a Cornish sea cliff No doubt as soon as darkness fell that same evening it would gain the edge of the cliff and make the great adventure True eels are found in all the rivers of Europe and North Africa, from the White Sea to Morocco, and also in the rivers flowing into the Mediterranean Yet if a sample of eels be gathered from any of these rivers and compared with a sample from any other, no difference can be observed between them It is true that the indi

viduals in each sample differ slightly from one another, some have a few more vertebræ in the backbone than others, but these differences are found equally in all samples

The reason for this uniformity of type became clear when Johannes Schmidt discovered the life history of the eel When eels reach the sea they all swim to the same breeding place, a spot situated in the Atlantic Ocean a short distance south of the Bermuda islands There they spawn, the females shedding the eggs and the males the sperm into the sea at random, where their union is left to chance, and thereafter the adults die Thus it comes about that the eggs of an eel from Morocco can be fertilised by sperm from a male from the North Sea, and if local conditions tend to produce local races, this tendency is neutralised by the constant crossing of the germ cells of individuals coming from different places The fertilised eggs develop into flattened semi-transparent larvæ with white blood utterly unlike the parents and they take three years to reach the streams from which their parents came

Contrast with this condition of affairs the habits and life history of the viviparous eel In this fish, the eggs after fertilisation are retained inside the oviduct and there develop into little replicas of their parents, ready to take up the parental life as soon as they are born They do not move far from their birth place, but form communities which interbreed chiefly with each other, and these communities show slight differences in structure from each other, even when as in Denmark they are separated from each other by distances so small as fifteen miles For example, a community living at the mouth of the Lym fiord differs slightly from one living farther up the fiord

Now no one will maintain that these differences have been specially created, all agree that they have arisen out of something in the local conditions The important point to note is that they are functional differences The eels from the mouth of the fiord are longer and slimmer than those living higher up, this difference in shape is a difference in the organ of locomotion, namely, the tail, which makes up two thirds of the fish (Fig 1) The fish near the mouth of the fiord go out into the troubled waters of the North Sea for their food and have to swim more strongly than their sheltered neighbours in the fiord Hence the difference in structure is correlated with a difference in habit If, then, these minute differences are the first steps in secular evolution, we may say that they demonstrate that ***habit is the driving force of evolution.***

THE SECOND PROOF OF EVOLUTION

(2) The second type of evidence is derivable from the remains of extinct animals, that is, fossils But only certain portions of this evidence are really convincing It is possible to take a series of fossil fish of different ages gathered in different localities and to arrange them in a series in the order of their supposed ages, and then to say that the series proves that evolution has gone on in a certain way It may be so, but it is always open to the objector to deny that the older members of the series are really the ancestors of the younger Some palæontological theories are based on series like this, but I have always been extremely sceptical as to their value I have harboured the suspicion that the younger fish in such series may have been

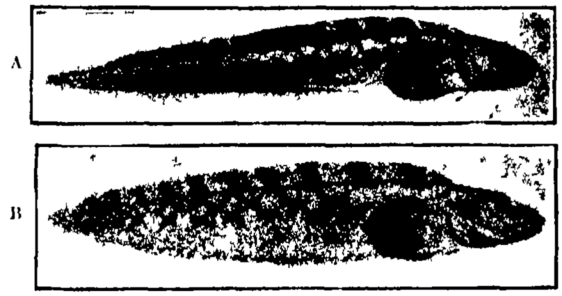

FIG 1 The viviparous eel (*Zoarces*) A The long slim open sea form B Shorter fatter form from enclosed waters

derived from fish contemporaneous with the older ones but as yet undiscovered

There are, however, certain exceptional cases in which a whole series of rocks in one and the same locality is full of the remains of the same kind of animals from top to bottom and where as we proceed from the older to the younger layers a slow modification in the structure of a particular animal can be seen, until, if we compare the youngest with the oldest layers, we seem to be dealing with quite a different species, though the difference between the specimens found in two contiguous layers may be so slight as to be inappreciable In cases like this, no doubt is possible that we are dealing with the same race of animals, which is undergoing slow modification, and these successions are known as *lineage series* The conditions for the preservation of such a lineage series are the persistence of a uniform deposition of silt in quiet waters in the same locality for vast periods of time The best two cases of such series known to me are the rocks in the western States of North America exposed in the sides of the Grand Cañon, and the English Chalk

In North America, the rocks are the beds of silt deposited by the annual floods of a great river

which originated in a large inland lake like the present Lake Superior Every year some of the animals grazing on the grass of the meadows bordering the river were drowned and their bones embedded in the silt In this way the whole story of the development of the camel and the horse has been elucidated, and, comparing the remains of these animals found in the lower beds with those in the upper, we can see the ancestors of the camels changing from four-toed quadrupeds into creatures like deer and thereafter into the splay footed modern camel The teeth of the earlier forms are in a complete series and the back teeth are studded with cusps Such teeth are found at the present day in animals which live on soft, succulent food As time goes on the cusps become connected by longitudinal ridges and the teeth are thus converted into mills suitable for grinding the harsh herbage of the steppes In the case of the horse we can begin with tapir like creatures with four toes on the fore feet and three on the hind feet and pass by an infinite gradation of stages to creatures with a single toe on both fore and hind feet like the modern horse The teeth pass from a condition with cusps to a condition in which the cusps are connected by ridges, but these ridges run obliquely across the tooth, not along it as in the camel

Now all these changes, both in the camel and the horse, take place with great slowness and are correlated with changes in habit The early ancestors walked on swampy ground as the tapir does now, ground where the spread of four toes was needed in order to give them adequate support As the ground became harder and dried, more and more reliance was placed on the central toes, and the lateral toes dwindled The tapir to-day lives on exactly the same kind of food as is indicated by the teeth of the ancestors of the horse

The English Chalk originated as a deposit of calcareous mud in quiet sea water a considerable distance from land, so that it was unpolluted by sand and mud borne down by rivers In this mud lived and burrowed heart-urchins in most respects very similar to the modern heart urchin, *Echinocardium*, which burrows in the sands of the Firth of Clyde Our modern urchin constructs for itself a cave in the sand, the roof of which is supported by a crest of curved spines which the heart-urchin carries on its back The cave communicates with the surface of the sand by a vertical shaft The mouth is on the under surface of the animal, not in the centre but pushed towards one side It is crescentic in shape, with a greatly projecting lower lip called the labrum On the back of the urchin there are five impressions radiating from the centre which remind one of the petals of a flower (Fig 2) These impressions are each composed of a double series of transverse grooves On each groove sits a broad, flattened tentacle which acts like a gill this tentacle communicates with the interior by two pores, one at each end of the groove Through these pores, the tentacle communicates with an internal reservoir known as the ampulla The right and the left series of grooves are separated by a median bare space One of the petals is markedly different from the other four It is more parallel-sided and the grooves are fainter and more numerous From this petal are given off, not gills, but very long tentacles terminated by frilled discs These tentacles are thrust forth two or three at a time through the vertical shaft on to the surface of the sand Here they collect small animals such as baby mussels, pull them down the shaft, and transfer them to a ring of branched tentacles surrounding the mouth, the so called buccal tentacles, by which they are pushed into the gullet, and so the heart urchin feeds The gills are continually bathed in a current of fresh sea water, which is sucked down the shaft and made to flow over the gills by the action of certain ciliated spines

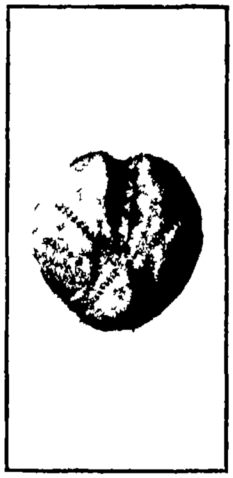

FIG 2—Denuded shell of the recent heart urchin (*Echinocardium*) showing the upper surface Note the grooved anterior petal

Now when we examine the chalk sea-urchins which are known as *Micraster*, we discover that they occur in certain places in countless numbers throughout a great thickness of strata, and we find that they slowly change their characters as we pass gradually from the lower strata to the upper The oldest *Micrasters* have the mouth circular in outline and entirely devoid of the projecting lip or labrum (Fig 3) The petals are short and are not grooved, and the anterior petal is not markedly different from the rest We interpret these features as meaning that these urchins, like the modern heart urchin, *Spatangus*, were only partially buried, the gills projected freely into the sea-water, and the tentacles from the anterior petal were comparatively short. The roundness of the mouth suggests that food was sought all round it from the sand on which the heart-urchin rested. As we pass upwards, the

mouth becomes more and more crescentic in shape, the labrum grows out over it and at the same time the anterior petal becomes more and more grooved This grooving indicates the gradual coming into function of the long tentacles as food gatherers Simultaneously the centre lines of the other petals between the two rows of gills become grooved and a sharp crest or ' carina ' is formed in the mid dorsal line in order to carry the spines which support the roof of the cave

All these changes are the result of a habit of burrowing deeper on the part of the sea-urchin As it sinks below the surface of the mud, it becomes necessary to hold the mud away from the gills, and so the crest or carina carrying the fan of curved spines is developed The buried gills require a more rapid current of clean sea-water over their bases and so the furrow in the centre of each petal becomes channelled out Every change in structure is correlated with a change in habit

For convenience, geologists pick out certain forms which occur at certain levels and constitute them types thus we have the zone of *Micraster cor bovis* But if we collect enough specimens, we find that these types are but arbitrarily chosen levels in an ever varying population Moreover, we find that the various characters, such as labrum, carina, grooved petals, do not change at the same rate in each individual In one, the mouth may be more crescentic but the petals less grooved than in another It is just as if the structure of each individual was responding to the change in its habits—but as if the different habits were not being modified at exactly the same rate in different individuals—in fact, as it has been dramatically

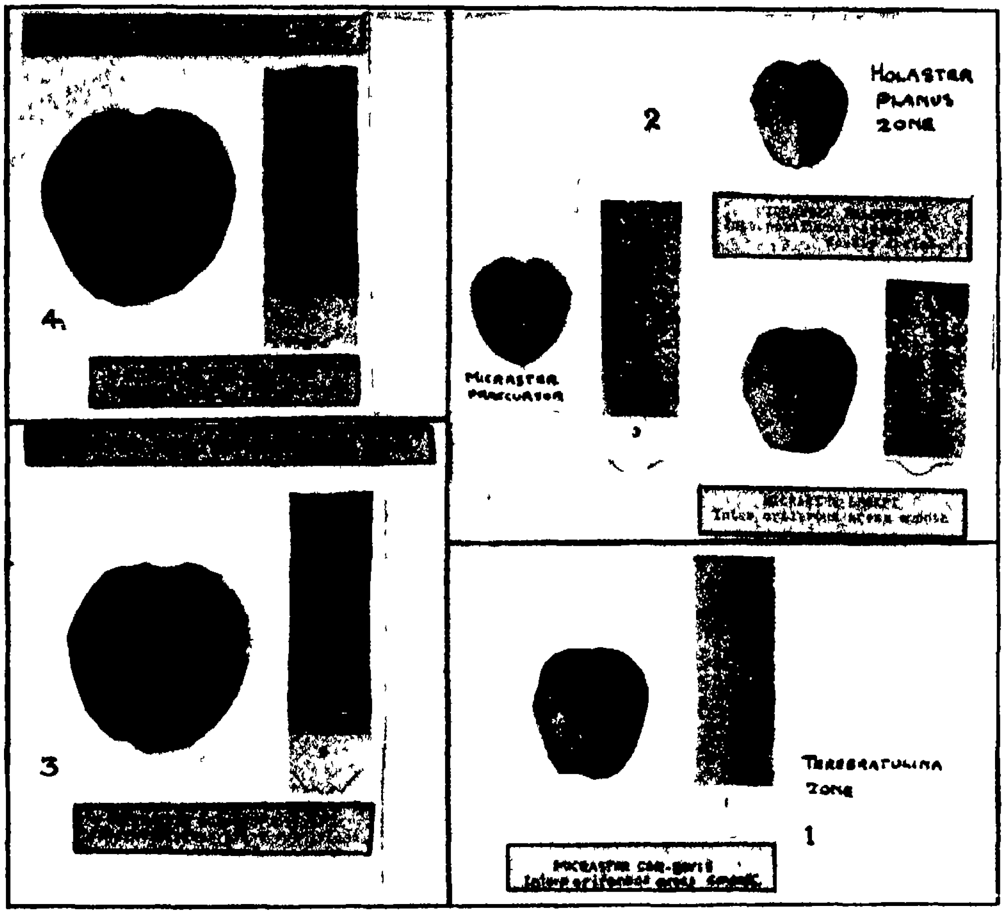

FIG 3—Four stages in the lineage series of the cretaceous heart urchin (*Micraster*) (1) is the oldest All show the upper surface (1) *Micraster cor bovis* (2) *Micraster præcursor* (3) *Micraster cor testudinarium* (4) *Micraster cor anguinum*

Changes in the interporiferous areas—On the upper surface of the sea urchin are five petal shaped tracts each formed of two rows of plates pierced by pores for the tube feet The middle region of each petal between the rows of pores is 'the interporiferous area In the lowest zone these areas are quite smooth, and the joints between the plates are not apparent In the following zones the areas undergo gradual change the successive stages being termed sutured inflated subdivided, and divided Thus in the highest zone the plates are divided by a median furrow, and are swollen and granulated

expressed by one of our leading palæontologists, it is as if an individual could have a new collar but last year's pair of boots

The evidence from lineage series thus confirms the conclusion derived from the study of local races that *change of habit is the driving force in evolution*

The Third Proof of Evolution

(3) The third class of evidence is much more disputable than the first two, but if it can be established that it is valid, it is of much greater importance, because it is far more wide reaching This evidence is the life history of the individual, which, according to the so-called 'biogenetic law' of Haeckel, is a 'recapitulation' of the history of the race This theory, at various times, has been heavily attacked It has been asserted that there is no inherent reason why the individual in its development should rehearse its ancestral history, and that in many cases it is impossible to imagine a functioning adult animal at all similar in character to the embryo

The assumption that the animal does repeat its ancestral history involves a theory of the time at which 'variations', that is differences between one generation and the generation which preceded it, manifest themselves Geneticists are prone to assert that variations are due to chemical changes in the egg and that this changed chemical composition manifests itself as a changed growth at all stages in development Eimer, however, the inventor of the term 'orthogenesis', maintained on the contrary, as a result of his detailed comparison of allied species, that new characters appear only towards the completion of growth and then first in males The dispute has arisen, as so many disputes arise, from the confusion of two different types of phenomena The geneticist is considering the abnormal, non functional and monstrous deviations of growth shown by our domesticated animals, these are due to interferences either with the egg or with the very young germ, they often, but not always, show themselves at the beginning of development, and the individuals showing them are always physiological weaklings as compared with the typical animals That these 'sports' or 'mutations', as they are called, are really due to chemical changes in the protoplasm, I am by no means ready to concede, the evidence available points rather in the direction of their cause being specific weakening of the powers of growth It is a remarkable fact that when these weaklings are returned to normal conditions and still are able to survive, their offspring revert in a limited number of generations to the normal type The systematic zoologist, on the other hand, deals with specific differences and Eimer is right when he says that these are manifested only at the end of growth, the youthful forms of allied species are notoriously so like each other as to be almost impossible of distinction

If we compare two species belonging to the same genus, one of the generalised type common to the tribe and the other of a specialised type, it will be found that the youthful form of the specialised type resembles closely the generalised type If we reject the doctrine of special creation and adopt the hypothesis that the two species have been developed out of a common ancestor, then it follows inevitably that the more specialised repeats, in its later development at least, the history of the race We can only have definite proof of this biogenetic law when we have independent means of knowing what the ancestry of a particular species has been, and, as has already been pointed out, this is possible in only a few cases, and the knowledge thus attained throws light only on the latest phases of racial history But the developmental history of all the higher animals begins with the egg—which in its essential structure is an amœba like protozoon—and therefore this development should present in shortened and simplified form the whole story of the race from its emergence from the protozoon level to its culmination in the adult form of the species We have no certain means of testing the accuracy of the earlier part of this record, but if we can bring strong evidence to show that the later phases do really represent ancestral structure, and if we can by comparative embryology elucidate the secondary causes which have modified the ancestral record, then I think we are justified in the faith that the whole development is a story of the evolutionary history of the race

Larvæ and Embryos

Now one of the most important things to notice is that the development exhibits two phases, both of which are always present but which are of very different relative duration in different species These are the *embryonic* and *larval* phases In the embryonic phase, the young creature is sheltered from the outside world, but in the larval phase, it leads a free life, seeking its own food and avoiding its enemies The latest phases of development are always larval, for no animal is born exactly like the adult condition The earliest phases, on the contrary, are always embryonic, because no egg is

ever cast naked on the world, every egg is sheltered for a longer or shorter time either inside an egg membrane or the mother's body

Now it is easy to show that the larval mode of development is the primitive one, of which the embryonic is a secondary modification For the organs of the larva are used, whereas those of the embryo are non-functional Thus there is a toad called *Hylodes* which lives in the West Indies and frequents localities in the damp undergrowth which are far from water This toad lays large eggs from which hatch out minute fully-formed toads If, however, one of these eggs be opened about half way through its development, there will be found therein a tadpole with fully developed tail and internal gills like those of the tadpole of the ordinary toad which lives in water Therefore if we are seeking the original meaning of development, we must concentrate our attention on species with a long larval development

When we do so, we find in many cases, notably in the life-histories of the Crustacea, that the larval phase is broken up into a series of sub phases or 'instars', and that during every one of these the larva has a distinct set of organs and corresponding habits, so that the primitive type of development consists of the coming to the surface of a series of habits, and when a species deviates from the habits common to the order in the last phase of development, it exhibits the habits typical of the order in its younger phases Of this we may cite one example which is familiar to many From the egg of the common shore crab, *Carcinus*, there hatches out a small shrimp like creature known as a *zoaea* This larva has a rounded and shortened fore part of the body known as the cephalothorax and a long thin hinder part divided into six segments known as the abdomen The cephalothorax has a spike projecting upwards from the centre of the back, and also one in front which is known as the rostrum At the sides of the rostrum are two large stalked eyes, and behind these there are two pairs of short feelers Beneath is the mouth and at the sides of this are situated three pairs of jaws or 'gnathites', which are practically identical with those of the adult crab Behind these jaws we find two pairs of comparatively long forked legs, the so-called maxillipedes This list comprises all the limbs which the zoæa possesses By using the maxillipedes as oars it rows itself vigorously about, grasping at any food which comes within its reach by means of its jaws, and it employs its abdomen as a rudder

Like all Crustacea, the zoæa is enclosed in a stiff horny cuticle or shell which impedes growth Nevertheless, growth goes on, small buds appear at the sides of the segments of the abdomen prefiguring swimmerets, and behind the maxillipedes other buds appear, the first indications of the normal legs of the crab The zoæa moults four times, and after each moult comes a short period of unimpeded growth during which the leg buds increase slightly in length but the abdominal buds become fully developed swimmerets Then comes a fifth and critical moult and the larva changes into a *megalopa*, which sinks to the bottom and has different habits For now it has legs behind the maxillipedes with which it can crawl, and it takes on habits like those of the shrimp Like the shrimp, it can still occasionally swim, using for this purpose, however, the abdomen with its swimmerets and not the maxillipedes

After a brief period of this kind of life, the megalopa undergoes another moult from which it emerges as a creature with a broadened cephalothorax but a reduced abdomen, no longer used for swimming but tucked underneath it, in a word, it has become a crab But the crab has not yet attained the complete features of the adult crab For one thing, the abdomen retains a full set of swimmerets It grows older and bigger, undergoing a series of moults At last, there comes a crisis when it assumes the full sexual characters of the adult These characters are indicated by far-reaching modifications of some of the swimmerets It might have been expected that as moult succeeded moult the swimmerets would gradually change into sexual organs When the crisis arrives they are re-absorbed into the body, their outer horny shells are cast off in the moult Underneath the next shell they re develop as buds, which grow into the shape of the sexual organs, and after the next moult they appear in their fully developed form

This history shows clearly the stuff of which development is made, we see a succession of 'powers of growth' coming into action one after another, each set of growth powers gives rise to a corresponding set of organs, and each set of organs corresponds to a new set of habits Development can thus be analysed into a superposed series of habits, and thus it affords another confirmation of the theory that *habit is really the governing factor in evolution*

The Effect of Acquired Habit on Heredity

We have yet to face the really fundamental question How does habit govern evolution?

Does habit change first, and do the changed habits produce the modified structure, or do structure and habit both 'vary' in all possible directions, and when the right habit and the right structure 'happen' to coincide in some fortunate individual, is this individual 'naturally selected'? In a word, does Darwin's theory of evolution by natural selection cover the case of correlated changes in habit and structure?

Now, in a sense, the theory of natural selection does cover this, and all other possible modes of evolution For if evolution has gone on at all, the powers of growth of one generation must have become altered as compared with those of a previous generation, and this alteration is what is known as 'variation' Again, if evolution has occurred, the individuals which have evolved must have continued to live, that is, they must have survived To say that an individual has been 'naturally selected' is merely to say that it is there Consequently the theory of evolution by natural selection is worse than a fallacy—it is a truism, it pretends to give an explanation which turns out on examination to be no explanation at all, but a mere form of words It is obvious that the real problem is glossed over, it is hidden in the word variation or *change* Until we have explained that, we have not really attacked the problem of evolution at all

Darwin implicitly assumed that inheritable variations in all directions turn up 'at random', so that the right combination is always there to be 'naturally selected' If this were really so, we should have to investigate the causes which produce these 'random' variations, for 'chance' or 'contingency' is no scientific explanation But the so-called pure line investigations prove conclusively that Darwin's assumption is wrong In phanerogamous plants, in Crustacea and in Protozoa, it has been proved that if we raise a brood from one parent only, either by self fertilisation as in the case of the plant, or by parthenogenetic reproduction in the case of the crustacean, or lastly by the asexual process of fission as in the case of the protozoon, the members of the brood will differ from each other slightly in size and proportions, but the shorter individual will give rise to a brood of grandchildren as long as, or even longer than, those of the longer individual These individual differences, or 'fluctuating variations' as they are called, are due to differences in nutrition and are not inheritable

If we abandon, then, the theory of random variations, we have to face the only alternative left, namely, that change of habit produces change of structure This is the theory of evolution put forward by Lamarck, as can be shown by quotation from his "Philosophie Zoologique" "Every fairly considerable and permanent change in the environment of any race of animals works a real alteration in the needs of that race Every change in the needs of animals necessitates new activities on their part for the satisfaction of those needs and hence forms new habits Every new need necessitating new activities for its satisfaction, requires the animal to make much more frequent use of some of its parts which it previously used less and thus greatly to develop and enlarge them A more frequent use of any organ gradually strengthens, develops, and enlarges that organ, whilst the permanent disuse of any organ imperceptibly weakens and deteriorates it, and progressively diminishes its functional capacity until it finally disappears All acquisitions and losses wrought by Nature on individuals through the influence of the environment in which their race has *long* been placed and hence through the influence of the predominant use or permanent disuse of any organ, all these are preserved to the new individuals by reproduction"

This theory is what is termed 'Neo Lamarckism' in order to distinguish it from the full evolutionary theory of Lamarck, for Lamarck believed that the principal factor in evolution was a sort of urge towards perfection which was inherent in living things, and that this urge was modified and even diverted from its course by the effects of the formation of new habits Now, in order to prove the truth of Neo Lamarckism, it is necessary to bring evidence that the formation of habits in one generation affects the next generation We must also try to show how this is possible, remembering that each member of the new generation begins its existence as a tiny germ cell, and that whatever influence is carried over from the previous generation must be somehow embodied in this cell Of course, it is generally admitted that the formation of a new habit modifies the growth, and therefore the structure, of the generation by which it is formed We are all familiar with the enormous arms of the prize fighter, and the greatly strengthened legs of the professional dancer But, to many people, it is difficult to believe that the strengthening of one particular organ should so affect the germ cell that in the new animal produced by it the same organ should be strengthed as was strengthened in the parent

Perhaps the best piece of evidence so far obtained

is that which emerges from the experiments of Dürkhen These experiments lasted five years and the animal dealt with was the common white butterfly, *Pieris brassicæ* Dürkhen discovered that if the caterpillars of this larva were reared in boxes provided with lids of orange tinted glass, they would metamorphose into pupæ the pupal coverings of which, instead of being coloured dirty white as in the normal pupa, were transparent Since the blood of the pupæ is coloured green, this blood shines through the transparent cuticle and the pupa appears to be green The pupæ were allowed to live until the white butterflies escaped from them These butterflies were carefully preserved in large cages exposed to the air and light but protected from the attacks of birds by a double belt of close wire netting They were fed on sugar and water, and after a week or two they paired and laid eggs, which were carefully preserved Then these eggs were reared up into caterpillars Half of these caterpillars were subjected to the same treatment as their parents, but half were reared in ordinary daylight The results obtained were as follows From the original generation of caterpillars 66 per cent of green pupæ were obtained, from the second generation reared under orange light 95 per cent green pupæ resulted When the offspring of the first generation of green pupæ were reared in ordinary daylight, 34 per cent of green pupæ resulted The normal percentage of green pupæ found in ordinary cultures where no coloured light was employed was 4 per cent These experiments show clearly that when a habit is acquired by one generation, a second generation exposed to the same conditions acquires the same habit more quickly and thoroughly, and that when the offspring of a generation which has acquired a peculiar habit are returned to normal and typical conditions they still show the effects of the habits acquired by the parental generation

These experiments were repeated by Heslop Harrison on the allied species *Pieris napi*, the turnip white butterfly In this species, the first generation of caterpillars reared under orange glass gave rise to 94 per cent green pupæ, whilst the second generation reared under the same conditions gave also 94 per cent green pupæ, thirty of these second generation caterpillars reared in daylight all gave green pupæ The percentage of green pupæ found in normal cultures was, however, higher than in *Pieris brassicæ*, reaching 20 per cent

Heslop Harrison carried out another series of beautiful experiments to show how an ingrained habit is inherited There is a gall fly, *Pontania salicis*, which normally lays its eggs in a particular species of willow (*Salix andersoni*) Harrison found that by hatching the insects out of the galls of this species and letting them loose in his garden, they could be forced to lay their eggs on another species of willow (*Salix rubri*) when the first species was not available During the first years there was a heavy mortality and only a few of the gall flies succeeded in establishing themselves on the strange willow, but when the experiment had lasted for five years Harrison reintroduced the original species of *Salix* into his garden, but the saw flies continued to lay their eggs on *Salix rubri*, to which they had been accustomed The acquired habit had therefore become hereditary

Perhaps the best example of the inheritance and transmission of an acquired habit is afforded by the experiments of Metalnikoff on *Galleria*, a moth the caterpillars of which feed on beeswax If the caterpillars of this species are reared in an incubator at a temperature of 30° C they will pass through their entire development in a period of 6–8 weeks, so that as many as six or eight generations can be reared in a year The caterpillars are extremely susceptible to attacks by the cholera bacillus, but, as is well known, a vaccine immunising against the attacks of this bacillus has been prepared, and if this vaccine is injected into the caterpillars when very young they resist the toxins produced by the bacillus Metalnikoff began his experiments with a brood of caterpillars which were the offspring of a single female He 'immunised' half of these with the vaccine and then inoculated the whole brood with the cholera bacillus After three or four days the survivors were counted and allowed to develop and become the parents of the next generation The same procedure was adopted with the next generation This generation may be called the first filial generation and its offspring is then the second filial generation None of the unprotected members of the first or second filial generation survived, but of the third filial generation 30 per cent survived In the sixth filial generation the proportion of survivors had risen to 42 per cent, and in the ninth filial generation to no less than 75 per cent

Metalnikoff remarks that the reason why previous experiments designed to test the theory that acquired habits are inherited had given negative results was that the experimenter had been content to rear two or three generations only "Time pays no attention to experiments in which she is left out of account"

Entomologists have long been familiar with what are termed biological races within the species By

this is meant races which nearly or entirely resemble each other in structure but differ in their habits, notably in the species of plant or animal which they attack The same kind of races are encountered in other groups of animals Dr Goodey has described them in the case of nematode worms Thus *Ascaris lumbricoides*, a worm about six inches long, is found both in the human intestine and in that of the pig Nevertheless, if the eggs of the human *Ascaris* are eaten by the pig they fail to develop in its intestine In Trinidad, a large proportion of the pigs are infected with *Ascaris lumbricoides* but the pig keepers, who are principally Negroes, suffer very little from this parasite, although, when one considers their habits, their food must be constantly polluted with the eggs of this worm

Again, the nematode, *Heterodera schachtii*, attacks beetroot The male remains in the earth, but the female bores into the plant and swells up to the size of a lemon seed which it resembles in shape and appearance In Germany there is a race of *Heterodera schachtii* which attacks the potato In this race the female when it swells assumes a spherical form It is very difficult to get this race to live in the beetroot, but by planting beetroot for three years running on land infested with the potato parasite, this was finally accomplished The females, although descended from the potato race, when they succeeded in maintaining themselves on the beet assumed the form of a lemon seed

Goodey attributes the formation of these biological races to 'food memory' By this he means that the female transmits to its offspring some substance which induces them to seek out the same kind of plant as that in which it lived He thinks that this is not quite the same as the inheritance of acquired characters But it is inherited habit and, as has been pointed out, this is what Lamarck meant by the inheritance of acquired characters habit changes first and structure follows only long afterwards

Dr Thorpe, in an article entitled "Biological Races in Insects" (*Biological Reviews*, vol 5), has given numerous examples of these races From his interesting article we select the following cases The louse which infests the human hair (*Pediculus capitis*) differs slightly from that which hides in the clothing (*Pediculus corporis*) in colour and shape (Fig 4) Nuttall bred the head louse, *Pediculus capitis*, for two years in boxes and found that it was completely changed into *Pediculus corporis* *Hyponomeuta*, the small Ermine moth, attacks the apple, the hawthorn, and the blackthorn The forewings of the moth are said to 'vary' in colour from dark grey to pure white, but it appears that the 'varieties of colour' are correlated with the plant attacked, for the white variety was found most frequently on the apple and the dark-grey on the hawthorn When larvae taken from the hawthorn were allowed to pupate in cases containing both apple and hawthorn, they laid 911 eggs on the hawthorn and 237 on the apple Thorpe remarks that the offspring of a generation reared on one plant and forced to feed on another will produce a third generation which will prefer the second food plant to the ancestral one, but will not entirely pass over to it when offered a choice of plants, so that the change from one set of habits to another is progressive, not effected at once as it should be if it were merely a case of 'memory'

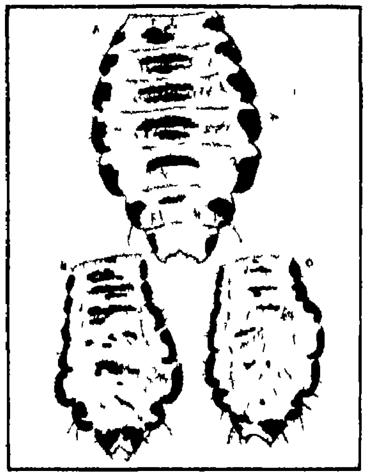

FIG 4 – The abdomens of varieties of the human louse (*Pediculus humanus*) A Body louse B and C Head louse

Another group of animals in which the production of new races by the formation of new habits is going on is the fishes which inhabit the torrential hill streams of India These fish which have been beautifully described by Hora, have evolved modifications of the ventral surface which enable them to cling to stones and avoid being swept away by the current We may select the carp like fish *Garra rupeculus* for special description Of this fish, Hora collected a large number of specimens of varying sizes He found that when they were very small (13 mm) in length the mouth was nearly terminal and was bordered by its proper upper and lower lips As it grew larger, a so called anterior labial fold made its appearance, which in its growth pressed the mouth downwards and backwards and the true lip inwards Behind the true lower lip another fold, the posterior labial fold covered over with papillae, makes its appearance This is crescentic, with the concavity turned backwards, and between the arms of the crescent a disc-like area of callous skin appears which the fish presses against the stones so as to act like a sucker The lateral extremities of the true posterior lip grow backwards and form lateral

borders to the sucker A tuberculated ridge of skin forms its hinder margin These stages, which Hora believes to be all growth stages of *Garra rupeculus*, are paralleled by the adult stages of other species of *Garra* The differences in development of the sucker are correlated with slight differences in the velocity of the current, and hence in the efforts which the fish has to make to hold on to the substratum

If we sum up all this evidence, we arrive at the conclusion that these biological races owe their origin to the inheritance of acquired habits, and in them we see the very first stages in evolution I cannot sympathise with the remarks made by Dr W T Calman in his address to Section D (Zoology) at the meeting of the British Association at Bristol in 1930 Dr Calman stated that the cases adduced to prove the inheritance of acquired characters concerned characters so slight and fugitive that they could have played no effective part in evolution Since, as all admit, evolution has been a very slow process, it could only be the very smallest steps in it which could be demonstrated during the period of observation open to a single observer Many people appear to think that in order to prove the inheritance of acquired characters, it would be necessary to show that when a structure had been changed by the exposure of the animal to a new environment during one generation, the same structure should be inherited in full strength by the next generation when the new environment had been changed back into the old and typical one This shows a complete misunderstanding of the real state of affairs When a structure changes owing to the action of a new environment, this is because it responds to the change by a new rate of growth, if the offspring are replaced in the old environment, this means that they come again under the influence of that environment, and their mode of growth tends, of course, to respond to the old and typical environment To prove that the habits and mode of growth acquired in one generation do affect the next, all we require to show, and all we could expect to see, would be that there was an *intensification* of the effect when the exposure to the new environment was continued for several generations, and a *lag* in the resumption of typical characters when the *offspring of individuals which had been exposed* to the new environment were replaced in the typical environment These expectations are amply borne out by Dürkhen's experiments on pupæ and Nuttall's experiments on the louse, to name only two examples

The Mode of Transmission of Acquired Habit

Even if we succeeded in showing that the characteristic features of allied species were correlated with the habits of each particular species, many people still feel a hesitation in admitting that the habits have caused the characters To revert to the case which has just been considered they would ask, how can the fact that the *Garra* fish in one particular place have to press their discs more tightly against stones, and thus enlarge them, so affect their germ cells that these, when they develop into little fish, will have larger discs? Is a picture of the parent repeated in miniature in the germ cell? Even if we could admit this, we might ask how the germ cell picture was altered when the parent was altered

Now the study of embryology, and in particular of experimental embryology, affords, as it seems to me, a satisfactory answer to these conundrums Whatever the embryo is, it is not a machine, that is, as Driesch expressed it it is not a constellation of parts in fixed relations to one another, and this is the only exact meaning that can be given to the word 'machine' It begins as a single cell and this multiplies by division into a number of cells, and *in each cell slumbers the power of developing into the whole* The nucleus as is well known, is the centre of the growth powers of the cell, but what a particular cell will develop into depends not on its inherent capacities but on its position in the whole It is dominated by the whole, and this is what Driesch meant by 'entelechy' The early development of sea urchins affords beautiful examples of this When the egg divides so as to form a blastula, a portion of this blastula can be cut off the remainder contracts so as to heal the gap and produces a small larva with all the organs developed but of reduced size Further, when the egg has divided into a few cells, the mutual positions of these can be altered by pressure so that cells that should be in front lie at the sides and vice versa, yet it develops into a perfect larva All the cells are equipotential But this state of affairs does not continue After a time the gastrula stage supervenes, when one pole of the blastula flattens and is pushed in like a finger, so that the rudiment of the gut is formed If just before this stage supervenes the top half of the blastula is cut off, this top will grow into a new blastula, but will develop no further, whilst the bottom half will heal up and proceed with its development and form a perfect larva

Later in development the front cœlomic pouch on the left side gives off a little bud which grows into the water-vascular ring-canal of the adult sea-urchin From this canal all the beautiful tentacles of the adult grow out This bud modifies all the tissues in its neighbourhood The skin covering it gives rise to a crown of beautiful pointed spines Where the posterior cœlomic vesicle is overlapped by the bud, this vesicle gives rise to the chisel like teeth of the urchin Under stimulation of the growth of the larva the front cœlomic pouch on the *right* side may also give rise to a water vascular bud When this takes place it transforms all the tissues of the right side of the larva, diverting them from their normal course of development and transforming into replicas of the tissues on the left side of the larva

How have these changes come about? Since the nuclei govern the whole growth and metabolism of the cells, it can only be because the nuclei in a certain part of the embryo have emitted some new substance into the protoplasm which has altered its growth So that we are confronted with the paradox that the nuclei, which are alike and all of which possess all the powers of developing into the whole, when once the development of the whole has started, develop only portions of their powers appropriate to their position in the embryo and produce these powers one after the other in a definite order The most marvellous example of this has been described by Brachet The egg of the frog, he found, can be entered by as many as seven spermatozoa One of these unites itself with the egg nucleus—in a word, fertilises the egg—and then this double or zygote nucleus starts dividing and organising the protoplasm into cells But the other spermatozoa start doing the same thing, and as they are only half the size of the double nucleus, the cells which they form are much smaller and easily distinguished from those formed by the zygote nucleus Thus there may be no less than seven centres of cell formation in the egg, yet out of this medley is produced not a seven headed monster but a single tadpole

Just as the whole in development dominates and directs the growth of the parts, so, in reaction to the environment, the whole animal enters into the reaction and every part is co ordinated with every other part When, for example, a lion springs on its prey, every muscle in its body comes into action, some are contracted, others are relaxed, for it is not the individual organ which reacts to the stimulus but the whole animal The reflex actions of excised muscles with which human physiologists have chiefly occupied themselves give no picture at all of what goes on in the intact animal striving under the influence of what Lamarck calls its 'inner feeling', and Rignano its 'affectivity', to escape from its enemies or to seek its food or a mate

If we make the reasonable assumption that every such action has a reciprocal effect on the nuclei, and stores up something in them which is given forth when the action is repeated and accelerates and strengthens it, then we can make a provisional picture of the *modus operandi* of the inheritance of habit For since all the nuclei are potentially alike, any one of them may become a germ cell if it finds itself in the proper position in the developing egg, and the nuclei of the germ cells will receive, like the nuclei of the other cells, the after-effects of the animal's actions When the germ cells develop into the new generation, these deposits will become active at the corresponding period of growth of the embryo and will stimulate this growth If the habit continues for many generations, more of the deposit will be formed every generation with an increasingly powerful effect on growth The modified structure will be formed on ever slighter stimulus, until finally so much of the deposit is accumulated that the organ develops without stimulus at all, like the eye of the baby rabbit in the darkness of its mother's womb

In the light of this hypothesis, we see why development should be ultimately analysable into a superposed series of habits, and why in the last resort *habit should be the driving force in Evolution*

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Church Cottage, their home in Marylebone Road, was open house to friends of all ages In this oasis from London's rush, many sought both help and advice, none was refused Free from worry over the more material aspects of life, his help to those in straitened circumstances was often more than words Generations of students think with affection and speak with reverence of their old teacher and friend Childless himself, *they* were his ' boys and girls ' When he came to King's, our College was enriched, by his death the whole scientific world is made poorer

It is difficult to write truthfully about Halliburton without appearing to exaggerate His character, his scientific accomplishments, his nature, his industry, his very life itself, make him one we can but mourn and do no more than try to copy

J A HEWITT

DR RUDOLF MARLOTH

WE record with deep regret the death of Dr Rudolf Marloth, the distinguished botanist, who has been so closely associated with botanical work in the Union of South Africa Dr Marloth's profession was that of a consulting analytical chemist, but it is with regard to his botanical work that he is best known in the domains of science

On the foundation of the Botanical Survey of South Africa, he was appointed a member in the year 1918, but before that time he had gained a reputation as a botanist with a wide knowledge of the flora of the Cape region He was president of Section B of the South African Association for the Advancement of Science in Cape Town in 1903, and was president of the whole Association at Kimberley in the year 1914 He was also president of the Cape Chemical Society in 1913

Marloth was the author of many botanical works and in particular "Das Kapland", which was published in 1908 and gives a general phytogeographical account of the vegetation of South Africa This fine work is profusely illustrated, mainly from photographs taken by himself, for Dr Marloth was, among other things, an expert photographer and an acute observer of biological factors in relation to plant life Another monumental work is his "Flora of South Africa", planned to occupy four volumes, three of which have now been published, the first volume appeared in 1913, and this also was magnificently illustrated with both photographs and coloured plates This is not a 'flora' in the strict sense of the term, as only a portion of the genera and species is dealt with and the Gamopetalæ have not yet been published It is, however, a work which all those interested in the wonderful flora of the Cape region find indispensable for the proper study of the flowers of South Africa He also published, in the year 1917, a "Dictionary of the Common Names of Plants of South Africa" In this volume, some two thousand records of common names of plants found in South Africa are given, and the list is particularly useful to the overseas visitor, since the Dutch have common names for most of the more conspicuous and generally distributed plants One of his earliest works was his "Elementary Botany for South Africa", which was published in the year 1897

Dr Marloth travelled widely in Africa in the course of his duties as an analytical chemist, and had a wide circle of friends, particularly among the Dutch, who helped him considerably in his botanical studies In connexion with his work on the Botanical Survey, he collected together a fine herbarium, which was remarkably rich in the Euphorbiaceæ and other succulent plants belonging to the Cape Province The collection was rendered all the more valuable by the inclusion of photographs of these plants, giving their characteristic features in careful detail Such photographs in the case of 'fleshy' plants are of very great value to the botanical student, and his herbarium, which will pass to the National Herbarium at Pretoria, will be invaluable to botanists carrying on researches on the flora of South Africa

Dr Marloth was a man of great energy and a delightful companion in the course of a botanical ramble Having had an opportunity of spending some nine strenuous hours in his company on Table Mountain last November, one was able to realise the great extent of his knowledge of the Cape flora, and also his untiring energy as a walker, for despite his age, he was able to outwalk many a younger man His unexpected death will be a very great loss to botanical science, not only in South Africa but also to the world in general

A W H

PROF JAKOB ERIKSSON

JAKOB ERIKSSON, whose death, on April 26, we regret to record, was born in Hyllie, near Malmö, Sweden, in 1848 After a course of study at the University of Lund, he obtained his Ph D in 1874, and the same year was appointed lecturer (Dozent) in botany at the University A year later he was called to Stockholm, where, besides teaching botany in one of the State colleges, he was engaged as plant physiologist at the experimental station of the Academy of Agriculture In 1885 he became professor and director of the department of plant physiology of the Academy, a position which subsequently comprised the department of agricultural botany Prof Eriksson held this position until 1913, when he had reached the age limit, entitling him to a pension He, however, continued his research work until shortly before his death, and published several books and monographs during his retirement His primary interest centred on the study of the diseases of agricultural plants, more especially mildew, parasitic fungi, etc It was very largely due to his energy and initiative that the plant physiological laboratory at Frescati, near Stockholm, was created

Prof Eriksson was a member of scientific academies in several countries and received numerous awards for his contributions to the knowledge of plant diseases and their treatment A species of fungus in the Hysteriaceæ group has been named after him, and in 1923 an international prize for

research in plant pathology was instituted at Wageningen in his honour He represented Sweden at nearly all of the international congresses on horticulture and plant physiology, and devoted a large part of his time in the interest of the International Institute of Agriculture in Rome

In addition to the work mentioned above, Prof Eriksson took a keen interest in pomology, and for a number of years edited the *Journal of the Swedish Garden Association*

WE regret to announce the following deaths

Mr W F Denning, a leading authority on meteors, discoverer of several comets, and of world wide reputation as an astronomical observer, on June 9, aged eighty two years

Baron Kitasato, For Mem R S, of the Imperial Pathological Laboratory, Tokyo, Japan, noted for his work in bacteriology, especially with reference to the artificial production of immunity to disease, on June 14, aged seventy-two years

Dr R C Macfie, Thomson Lecturer in the University of Aberdeen for 1929, and author of a number of notable biological expositions, as well as of volumes of picturesque verse, on June 9

Dr Warner J Morse, director of the Agricultural Experiment Station, Orono, Maine, on Mar 25

Prof S W Parr, emeritus professor of practical chemistry in the University of Illinois, known for his researches on fuels, on May 16, aged seventy-four years

Mr H Tomlinson, F R S, formerly principal of the South-Western Polytechnic, Chelsea, on June 12, aged eighty four years

Mr R T Wright, formerly fellow and tutor of Christ's College, Cambridge, and secretary of the University Press, on June 11, aged eighty-five years

News and Views

THE doctrine of the inheritance of acquired characters is by no means so dead as its opponents thought a generation ago The effects of Weismann's knock out blow are wearing off, and the heart begins to throb again, somewhat irregularly, but gaining strength all the time In his Royal Institution Discourse of June 5, on "Habit The Driving Factor in Evolution", printed in a special supplement this week, Prof E W MacBride takes a strong stand on the side of the heritability of acquired characters Dissatisfied with the evidence formerly adduced for the occurrence of evolution, he re examines the question along three lines which he regards as the only possible approaches These are the line of racial differentiation amongst animals at the present day, the line of fossil evidences of past specific changes, and the line of embryonic and larval development And each of these lines, traced to its end, leads Prof MacBride to the conclusion, which would have delighted Lamarck as it will shock many adherents of orthodoxy, that habit or change of habit is at the bottom of the changes of structure which represent the difference between one species and another The interesting examples cited in support of the thesis will be eagerly scanned, but whether all of them will satisfy the doubters is another question

To take the case of the blenny or viviparous eel of the Lym fiord, the individuals of which at the mouth of the fiord are longer and slimmer than their relatives higher up, without direct proof it is unsafe to assume, and the argument is based on the assumption, that the difference is due to different habits May it not be that the differences represent responses to physical differences in the environment, such as varied densities or salinities? Racial differences may be due to habitat as well as to habit, and until the one possibility has been eliminated the other cannot be taken for granted In a similar way it is possible to imagine that the reversion of the spherical race of the nematode, *Heterodera schachtii*, in the potato, to the lemon seed form when it feeds again on beetroot, may be due to physical or chemical properties of the juices it feeds upon—a physical rather than an organic reaction But this sort of objection to regarding habit in every case as the initiator of structural change does not apply to other examples cited by Prof MacBride, and we view with sympathy his championship of the directive force of the organism in the evolutionary race

IN an article on "The Scientist and the Technologist in the Textile Industries", published in the *Journal of Textile Science*, Prof E F Barker discusses co operation between men of science and technologists and problems of their training Prof Barker points out that the technologist, or 'practical man', as he is frequently described in the textile industries, has attained his results much more by judgment and less by rule of thumb or haphazard methods than the man of science frequently imagines Examples are quoted of textile problems faced and evolved along inductive lines of reasoning by the technologist, which indicate that some technologists at least may claim to be scientific workers within the sense of Sir Arthur Eddington's definition of science as "an attempt to set in order the facts of experience" The training of the technologist in the best of our technical colleges has been based largely upon system and not mere synopsis, and upon basic inductive methods The technologist thus chiefly needs the cultural scientific training, based upon the extensive outlook or extensive "Science Discipline" suggested by Sir David Prain The man of science, on the other hand, is essentially an analytical worker, and a fundamental defect of our present university training is that, while taught to appreciate facts, its graduates are frequently quite unable to assess values, especially human values This defect has largely been responsible for the slightly contemptuous attitude towards industrial research once common in university circles, and makes the exclusion of the technologist from association with the man of science in the activities of the research associations catastrophic Probably nothing would more rapidly ensure the provision of adequate support for such associations from the industries themselves than effective co-operation between the scientific worker and the technologist.

PROF BARKER urges that the man of science, having passed through the cultural scientific training, should proceed to the sterner discipline of an intensive training in which studying, as Sir David Prain suggests, "everything of something" evolves scientific, mental, and material tools, and the capacity to use them intensively, by means of which he may draw from Nature more of her riches for the service of mankind The failure of scientific workers to attain greater success than they have hitherto attained is due to lack of appreciation of the problems which only broad co-ordinated enterprise can present for solution The training suggested should assist the scientific worker to clarify or to reveal for the technologist the problems and factors with which he has to work, and if the technologist by taking the extensive "Science Discipline" as part of his course acquires the scientific outlook, the required co operation between science and technology should easily be obtained Such collaboration, and the twin advance of science and technology, are essential if both are to play their part in solving the world problems which they have largely created The cultivation of a sense of values should, moreover, promote co operation with art and humanitarianism—those other aspects of industry which have their part to play in the future as in the past in correcting the soul destroying influences of mechanical work The success or failure of Western civilisation may, as Prof Barker suggests, depend upon the extent to which these aspects of industry function, not merely to serve the material interests of mankind by the secrets won from Nature, but to promote man's higher interests and the spirit of world fellowship

Antiquity, thanks to a vigorous and courageous editorial policy, has attained a position in periodical literature which in Great Britain is unique It has succeeded in maintaining its popular interest without thereby losing its attraction for more serious readers who wish to be kept abreast of the archæological movement in branches of study other than their own Thus, in the June issue, Miss Caton Thompson gives a brief preliminary account of the problems, such as the relation of palæolithic and neolithic culture to water supply, which the first season's work of the Royal Anthropological Institute's expedition to Kharga oasis is revealing for future investigation, while the series of air photographs by Lady Bailey are most valuable as indicating the nature of the terrain In the same way, Mr J Leslie Mitchell's "Inka and Pre Inka" is a useful summary of present theory for those who have not been able themselves to follow recent developments in South American archæology in detail Mr Cyril Fox's study of "Sleds, Carts, and Waggons" in Wales is not only a valuable record of the development and relation of types of vehicles which are now passing out of use, but is at the same time an instance showing how a highly specialised type which has developed in response to local conditions may survive for a considerable time even in the face of the standardisation of modern industry We refer to Dr Reisner's contribution on "Stone Vessels found in Crete and Babylonia" elsewhere, and must pass over other matters of moment in favour of a question raised by the editor in his "Editorial Notes"

IN his "Editorial Notes" the editor of *Antiquity* directs attention to the "astonishing fact that there exists no University Chair of what may be called Old English Archæology", meaning by that expression, the antiquities of the Saxon, Danish, and Norman periods To those who are not acquainted with the circumstances, while this may seem a matter for regret, it may not appear of special urgency There are other subjects of special study, of equal or even greater importance, which are without this provision But, as the editor justly points out, not only have some of the most recent monographs on Anglo Saxon antiquities been written by distinguished Continental archæologists, but also—and this is the more serious aspect of the matter—such knowledge as we have on the period, say, between A D 450 and 650, is concentrated in a few individuals whose numbers do not increase as time goes on, while for the period A D 700 to 1000 accurate scientific knowledge, based on proved fact, is almost entirely lacking Yet there is ample material in Saxon and Danish earthworks, for example, upon which no work of excavation has ever been carried out In view of the lack of encouragement given to these studies, there is a very real danger that research in this by no means uninteresting phase in our history may entirely die out The modern standard of scientific excavation is too exacting to make it advisable to rely on private effort, however successful this may have been in the past in the initial stages of other branches of archæological investigation, while the endowment of a chair would at least give organised direction to investigation, and probably provide the stimulus of open discussion and criticism which is essential to progress in this as in other similar studies

THE Empire Forestry Society has recently published a second issue of a most useful little work entitled, "The Empire Forestry Handbook" The handbook gives a list of office bearers and members of the E F Association, a list of forest officers of the Empire (not without its value, but liable to get quickly out of date), a list of higher forestry educational centres in the Empire, a list of Empire research institutes, a list of departments and institutions dealing with imperial forestry—incomplete, since several universities which, apart from education, certainly deal with imperial forestry are omitted, data and tabular statements purporting to give the forest resources of the Empire, but inevitably, in the case of large areas of our tropical forests in as yet imperfectly known regions, based on the roughest of estimates, and finally a useful list of trade names of Empire timbers which it is hoped gradually to get established

ON the subject of forest research institutes in Great Britain the following comment may be made Under these institutes the Forestry Commission is first mentioned, then the Imperial Forestry Institution, Oxford, and thirdly, the Forest Products Research Laboratory, Princes Risborough This ends the list of centres said to be undertaking forestry research in Great Britain, but

examples of such work being conducted in connexion with Empire forestry interests at other centres could be quoted Perhaps the simplest for reference is furnished by Dr Rayner's letter in connexion with forest research which appeared in NATURE of April 4 The paper alluded to, "Mycorrhiza in Relation to Tree Growth", was actually published in the *Empire Forestry Journal*, vol 9, No 2 1930 As was pointed out in the leading article in NATURE of May 16, on "Forestry Research in Great Britain", if forest research work for the Empire is really to pull its weight, the Forest departments require to harness every centre which is able to undertake such investigation work Dr Rayner has shown that Bedford College for Women, London, is capable of performing such work In the next issues of the Handbook it may be hoped that the editor will be able to find a place amongst his research institutes or centres, since the Forestry Commission, London, cannot be termed an institute, for the Bedford College for Women, and other places in Great Britain equally interested in Empire forestry research

THE radio equipment of recently built luxurious liners is now wonderfully complete The new liner, the *Empress of Britain*, is furnished with both long wave and short wave installations The latter waves enable telephone communication to be maintained over distances which are quite outside the range of the long wave transmitter Hence telegrams can be exchanged directly with the country from which the passenger comes, and this effects considerable economies Emergency and lifeboat radio equipment are also supplied The ordinary cabin telephones are connected with the short wave transmitter, so that the service is as convenient as when on shore London connects each cabin telephone with practically every telephone in Europe, and New York with Canada, the United States, and Mexico The Marconi repeater equipment enables the ship's band to be heard in any part of the ship There are eleven loud speakers for the decks and public rooms and two for private cabins They can be used for making announcements The loud speakers are mounted in the structure of the ship so as to harmonise with the decorations A special type of radio receiver enables broadcast programmes to be heard when they become available Gramophone records relieve the orchestra when necessary, and supply dance tunes Four large cabins are devoted exclusively for the radio apparatus The Marconi direction finder is installed in the chart room for the convenience of the navigating officers The radio equipment was installed by various companies acting on behalf of the Marconi International Marine Communication Co, Ltd

ON the occasion of the recent opening of its central laboratories, the British Non Ferrous Metals Research Association has issued a pamphlet entitled "Ten Years of Research for the Metal Industries", which provides, in a convenient form, an account of the work done by the Association since its formation in 1920 The main features of this work have been described on many occasions, and attention is now particularly directed to the efforts made, largely at the suggestion of the Director, to bridge the gap which undoubtedly exists between the solution of a problem in the laboratory and its general application in industry Even where, as in this case, the interest of the principal firms in the industry has been secured, the time lag which occurs between the issue of a laboratory report and the news that the report has had an actual influence on practice is so great as to disappoint those who have been most eager to promote industrial research The Association has done its best to diminish this time lag, first by an intelligence service which enables its members to keep abreast with work that is being done all over the world, and next by a Development Section, with its own trained staff, the duties of which will increase in importance as time goes on The new aluminium brass condenser tubes, the improved materials for locomotive firebox construction, and the ternary alloys of lead for the sheathing of cables are among the chief practical results of the work of the Association, and each of these calls for special effort in securing their general adoption by members

WHERE there are no civic regulations to the contrary, modern buildings in cities are ever growing taller In Europe, ten and twenty storeyed buildings are getting not unusual, and in the United States there are buildings with fifty storeys In order to let sun light reach the streets underneath, the buildings are made narrower near the top This makes the problem of providing shafts for the requisite lifts very difficult In the *Westinghouse International* for April, an interesting account is given of a method that has been adopted in an eleven storey office building in East Pittsburgh for increasing the transport facilities up and down the building There are two shafts in the building and each shaft has two cars At first sight it seems dangerous to operate two cars in the same shaft and on the same set of rails The difficulty has been overcome by running the cars to a fixed schedule Both complete their trips upwards before either of them starts on the return journey They thus always operate in the same direction The limits for the lower car are the bottom of the shaft and the upper car, and the limits of the upper car are the lower car and the top of the shaft For the dual control, the car is automatically slowed down and stopped before it catches up the other car In addition, a set of signals is displayed within the car, so that the passengers and operator know at once why their car is slowed down or stopped before it reaches its destination The control panel shows at each instant the location of each car and also illuminates three signal lights The green light indicates full speed, the yellow light slow speed, and the red light indicates a stop

CONSIDERABLE attention is being paid at present to the part that wireless will play in the future in the growth of international communication Many believe that it is only a question of time until it will become the universal medium for communication, and that wire and cable systems will become obsolete On the other hand, some believe that the future of wire-

less is very limited, and that it will be mainly confined to broadcasting and communication with and between mobile stations. It is quite possible that wireless will be displaced eventually from the broadcast field for local areas by the use of wire broadcast systems. In a paper published in *Electrical Communication* for April, H. H. Buttner discusses this question fully. He concludes that in the future development of international communication there will be a definite use for both wire and wireless systems. Short wave systems for long-distance communications are generally the more economical. But if the traffic is heavy, or if some is picked up on the main route, it is probable that the cable system would be the best commercially. Owing to atmospheric interference, wireless circuits can rarely give continuity of service over the twenty-four hour day. Cable circuits can also be interrupted by natural causes, possibly over a long period. Wireless can transmit to several stations at once, but the secrecy of cable systems is of great importance in war time. To a large extent, wireless and cable services are complementary to one another. Those services where wireless is essential, such as broadcasting, transoceanic telephony, meteorological and direction finding services, should not be hampered by being allocated too few air channels. The extension of wire and cable communication systems to localities not formerly served owing to economic reasons will release valuable wireless channels for the development and pioneering of new services where the use of wireless is essential.

THE Mineral Resources Department of the Imperial Institute has recently issued a most valuable survey under the title "Mineral Position of the British Empire" (1931, pp. 121, price 2s. 6d.). The mineral production of 1928, as compared with that of 1913, shows that the Empire has fallen back as compared with the world as a whole; but the chief cause of this is the extraordinary increase in petroleum production, to which the Empire contributes only a very small proportion. Otherwise coal and iron ores are the two chief mineral needs of industrial civilisation, and, in these, the Empire has enormous reserves, which should secure for it a high place in the world's industries for some centuries to come. The future outlook as regards supplies of copper and the other base metals, as well as the iron-alloy metals, can also be regarded as promising. Minerals which the rest of the world imports largely from the Empire are asbestos, china clay, chromite, diamonds, gold, mica, nickel, and tin. Minerals for supplies of which the Empire depends almost entirely on foreign countries are antimony, bismuth, borates, petroleum, potash, pyrites, quicksilver, sulphur, and radium. Of all other important minerals, the Empire has ample supplies and great resources, and in many cases an exportable surplus. The position thus disclosed as regards independence in the matter of mineral supplies is one with reference to which the Empire need not fear comparison with the rest of the world. The survey is of great interest and importance, and will prove to be an invaluable mine of information to a wide range of appreciative readers.

IN conformity with the decision of Marshal Lyautey, Commissioner of the International Colonial Exhibition to be held in Paris this year, the Seventh International Congress of Aquiculture and Fisheries is to be included in the programme of the Exhibition. The Congress will be in session from July 20 to 25 inclusive. According to details available in the preliminary syllabus now issued, it will be constituted in three groups, the first dealing with marine fisheries and allied industries, the second with river fisheries, and the third with overseas fisheries. Each of these main groups will be further divided into numerous sections and subsections, each of which will consider and discuss in detail some particular branch or aspect of the general theme. The findings of sections will be communicated to the main groups at combined meetings specially convened. In addition to purely technical work, members of the Congress will join in visits to the Colonial Exhibition and take part in certain of its deliberations. At the end of the meeting, a tour will be arranged to all the principal fishing ports of northern France, including Boulogne, St. Malo, Brest, Belon, and Lorient. Any further information regarding the Congress can be supplied by the General Secretary, 28 Rue Serpente, Paris.

IN a short paper in *Scientia* (vol. 49, p. 335, 1931) Prof. Paola Enriques, of Padua University, endeavours to find a way of conciliation between the apparent contradictions of heredity and evolution. Heredity, to put it broadly, is concerned with the conservation of the species, while evolution, on the other hand, is concerned with the transformation of the species. In the old days, observation of the relationships between parents and children left open a way for evolution, since children, however much they resembled their parents, in some characters were different. But genetics suggests that all the hereditary patrimony of the child can be decomposed into definite and known elements, so that no room is left for the evolutionary novelty. Enriques emphasises the significance of the fact, well known to systematists, that there is amongst related species or groups of species a combination of characters associated with the characters betraying affinity. Further, one set of characters may vary independently of the other. Experimental heredity shows also the possibility of variations in hereditary factors, so that there may be deduced a common law ruling both heredity and evolution, the law of 'independent variability"—"hereditary factors may vary independently of one another, and it is from the independent variations that the formation of new species is derived." So enters the possibility of evolution.

FUNGI form excellent objects of study for the amateur naturalist armed with the microscope, and the March issue of the *Journal* of the Quekett Microscopical Club contains two interesting papers in which different aspects of fungus study are discussed especially for the microscopist. The president of the Club, Mr. J. Ramsbottom, of the Natural History Museum, discusses some of the more interesting of the aquatic fungi, including in his account brief descriptions of

some little known groups in which the English forms, in particular, would well repay intensive study Mr B F Barnes, of the Department of Botany of Birkbeck College, London, discusses quite a different phenomenon By modern technique, using sterile solid media, fungi can be grown in pure culture for years and, thus cultivated, remain as constant in form and in the structure of their reproductive bodies as more highly organised plants It has thus been possible to recognise the fact that variable forms, which sometimes remain distinct in culture whilst in other cases they revert with time to the normal, may be produced from the stable normal types by special treatment Mr Barnes describes the variations he has induced in three different species by heating the spores from which sub cultures are afterwards made

During the last ten years great improvements have been made in photoelectric cells and in valve amplifiers In a lecture to the Royal Society of Arts on Feb 25, W G W Mitchell showed how these improvements have been of the greatest value in the development of television Comparing this art with that of picture telegraphy, where the tones of a photographic print are transmitted over a wire or wireless circuit and reconverted at the receiver end into a permanent record, he pointed out that with television, eighteen complete pictures must be sent out per second, and that the actual speed of transmission must be a hundred times quicker than in picture telegraphy The discovery by Baird that infra red rays could be used instead of the light from a powerful arc lamp made the process of being televised quite comfortable to the subjects The method of two way television over the telephone developed by the American Telephone and Telegraph Company was successful It is very expensive to install, and it has the great drawback of using up some fifteen ordinary telephone conversation channels A two-way 'conversation' by this method was successfully carried out in New York over a distance of two miles between two deaf mutes The conversation was maintained solely by reading lip movements The main difficulty that lies in the way of developing purely electrical methods such as the cathode ray method is the high voltage at present required for operating the necessary tubes The next big development will probably be the production of a picture of the size and brilliancy of the cinema screen picture of to-day This will probably be done by using zone methods of scanning in conjunction with wired transmitting circuits Television should prove a better aid to salesmanship than picture telegraphy It has already been found useful in connexion with researches on the Kennelly Heaviside layer Mr Mitchell expressed the hope that litigation on patents will not hold up the development of television as it did radio communication

The April issue of the *Scientific American* has a short description, with diagrams, of a sonic altimeter produced by the General Electric Company which has been used successfully by the Army Air Corps of the United States A high frequency whistle mounted in a megaphone pointing downwards sends out short blasts at regular intervals, the power being derived from a gas supply tank fed from one of the engine cylinders At each blast a pointer begins to travel round the dial of the altimeter and the pilot reads the position at the instant he hears the echo of the blast by reflection at the surface of the ground He is provided with a stethoscope connected to a second megaphone pointing downwards, mounted in the tail of the aeroplane An acoustic filter in the connecting tube reduces the engine and other aeroplane noises, and it is found that altitudes so low as 50 ft and so high as 1000 ft can be accurately measured even in the densest fog

Typhus fever in the Old World is transmitted by the body louse Recent *Daily Science News Bulletins* of Science Service, Washington, D C, report that Drs Dyer and Badger, of the U S Public Health Service, investigating typhus fever in Baltimore, have obtained evidence incriminating a rat flea as the agent transmitting this form of typhus fever, which may be a type slightly different from European typhus fever It is probable that there are several typhus like fevers, for there are forms of typhus fever in the East which are transmitted by ticks It is of interest to recall that Prof Matthew Hay, of Aberdeen, in 1907, before the mode of transmission of typhus fever was known, suggested on epidemiological evidence that the flea might be the agent

Messrs Bellingham and Stanley have recently issued a new illustrated catalogue of their spectrometric apparatus The general feature in the design of their instruments is the increasing departure, which is now fairly general, from the old conventional type based upon the rotating telescope and collimator Even where the Littrow principle of mounting is not applied, the instruments tend to be made in more compact and mechanically sounder forms, and, occasionally, to be constructed with interchangeable optical systems One spectrometer of rather special interest which has been built specially for the study of the Raman effect, but would be of use in the investigation of any feeble visible source when high dispersion was not required, is a large aperture instrument of aperture $F/2$, with a single prism and a lens of 16 cm focal length, the spectrum between 8000 A and 3400 A occupies a length of 16 mm Among other instruments listed is a polarising photometer for use in the visible and ultra violet regions

The New Physics Building of the National Physical Laboratory will be opened on June 23 at 2 15, by Sir F Gowland Hopkins, president of the Royal Society, and chairman of the general board of the Laboratory Other speakers will be Sir Richard Glazebrook, chairman of the executive committee, who will give a short account of the history of the building, and Sir J J Thomson, chairman of the research committee of the Laboratory At 3 o'clock the president of the Royal Society will proceed to the Main Aerodynamics building, to receive other visitors to the Laboratory

The Bakerian Lecture of the Royal Society will be delivered at 4 30 on Thursday, June 25, by Prof S

Chapman The subject will be "Some Phenomena of the Upper Atmosphere"

THE latest addition to the series of catalogues of Francis Edwards, Ltd, 83 High Street, Marylebone, W 1, is No 538, devoted mainly to "Voyages and Travels before 1750"

THE author of the article on "The Nature and Origin of Ultra Penetrating Rays" in NATURE for June 6, p. 859, writes that the following errors (present in his MS) were overlooked by him in the proof "At the end of the first paragraph '3 7 10^9 e volts' should read '1 9 10^9 e-volts' This error is repeated fourteen lines later Again, the same error appears in that at the bottom of the first column on p 860, 'At present this limit is about 4 10^9 e-volts' should read 'At present this limit is about 2 10^9 e volts'"

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A laboratory assistant for the medical unit laboratories of the Welsh National School of Medicine—D Brynmor Anthony, University Registry, Cathays Park, Cardiff (June 22) Two munitions committee research fellows at the University of Liverpool (Faculty of Engineering) —The Registrar, University, Liverpool (June 22) A lecturer in mathematics (with physics as subsidiary subject) at the Handsworth Technical College—The Principal, Technical College, Handsworth, Birmingham (June 23) A head of the Evening Building Department of the School for Building, Ferndale Road, S W 4, and a full time instructor of plumbing for day and evening classes at the same institute—The Education Officer (T 1), County Hall, S E 1 (June 24) An assistant lecturer in commerce at University College, Leicester —The Registrar, University College, Leicester (June 27) Two visiting teachers for chemistry and physics at the Norwood Technical Institute—The Education Officer (T 1), County Hall, S E 1 (June 27) An assistant lecturer in the Department of Political Economy of University College, London—The Secretary, University College, Gower Street, W C 1 (June 30) A demonstrator of physics at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S E 1 (June 30) A lecturer in physics in the Egyptian University, Cairo—The Dean of the Faculty of Science, c/o Egyptian Education Office, 39 Victoria Street, S W 1 (July 1) Seven chemical assistants in the Public Health Department of the London County Council—The Clerk of the L C C County Hall, S E 1 (July 6) A tutor of women students in the University of Leeds—The Registrar, University, Leeds (July 6) A half time assistant lecturer in botany at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (July 7) A demonstrator in physics in the University of Leeds—The Registrar, University, Leeds (July 13) A reader in organic chemistry in the Aligarh Muslim University (candidates restricted to Indian born subjects of the King) —Prof R F Hunter, Box 114, c/o NATURE Office A lecturer in charge of the Building Department of the Norwich Technical College - The Principal, Technical College, Norwich

Our Astronomical Column

Calendar Reform —A note in this column on June 6 referred to the widespread opposition to any break in the continuity of the seven day week An article by Mr L C W Bonacina in the *Evening Standard* of May 29 goes too far, however, in the opposite direction in resisting all reforms One of his main points is the sentimental association of certain old traditions with the present months But it may be pointed out that many of these associations have already been broken by the change of style Before the change the hawthorn flowered early in May, now it seldom does so till after the middle of the month Again, the old rhymes

Barnaby bright, the longest day and the shortest night
Lucy light, the shortest day and the longest night,

are no longer true The dates of the feasts are June 11 and Dec 13 The strongest argument for a change is, however, the utterly illogical arrangement of the length of the months Since the average length of a month is almost 30½ days, it is clear that all months should have either 30 or 31 days. The abnormal shortness of February is due to the pride of some Roman emperors, who wished their months to have 31 days It is strange that mankind has tolerated the anomaly for nearly two thousand years

Different methods of improvement are possible The simplest is to make the lengths 30, 31, 30, 31, etc, with the final 31 changed to 30, except in leap year Another arrangement is 31, 30, 30, 31, 30, 30, etc, with an additional 31 at the end, this has the advantage that the first three quarters are each exactly 13 weeks. The leap day should be placed at the end of the year, so that it does not alter the interval from one calendar date to another in the same year

It is clear that there is room for improvements, and the prospects of carrying them out are rendered brighter if they are not too drastic It would be wise to drop all tampering with the week, such a change excites strong opposition

A Very Massive Double Star —A *Daily Science News Bulletin*, dated Washington, May 20, reports that another very massive double star has had its mass determined, by Dr J A Pierce, at the Dominion Observatory, Victoria, B C It will be remembered that the greatest star mass hitherto measured was that of the spectroscopic binary in Monoceros known as the 'Plaskett Star', since it was detected by Dr J S Plaskett, director of the Observatory at Victoria That consists of two stars of nearly equal mass, each at least 80 times as massive as the sun, since eclipses do not occur in that star, the exact masses cannot be given, but must be somewhat greater than the above Curiously, the bulletin omits to give the name or position of the newly measured binary, which is one of the most important items in an announcement of this kind, it is stated that its binary character was detected at Mt Wilson between 1920 and 1924, but it has been the subject of more exhaustive study with the 72 inch reflector at Victoria, since the report mentions "spectroscopic and other photographs", and also gives exact values for the masses (not merely minimum values), it may be concluded that eclipses have been detected The period of revolution is 56 days, and the masses of the components are respectively 134 and 50 times that of the sun The centre of gravity is receding from the sun at the rate of 8 km /sec

Research Items.

Chronology and Archæology.—In *Antiquity* for June, Dr. G. A. Reisner examines the method of dating by means of objects from Egypt with special reference to stone vessels found in Crete and Mesopotamia, and incidentally lays down certain principles for its employment. (1) Conclusions have often been reached on the dating of single objects found in Egypt and little attention has been paid to its range. It is, therefore, necessary to know the whole range of time during which the object occurs in Egypt and the variations in form which it assumes in that time. (2) An Egyptian object found abroad must be identical in form, material, and technique with a type of known range in Egypt. It must be remembered also that most objects in Egypt pass through two stages of development, an earlier stage of practical use and a second in which more or less degenerate examples are made for burial purposes only. Taking the history of stone vessels in Egypt, it would appear that the period during which we might expect an export is that from the time of Zer (third king of Dynasty I.) to the end of Dynasty III., but the export as gifts, especially royal gifts, might have taken place down to the end of Dynasty V. or even VI. Examining the evidence from the royal site at Knossos, it would appear that there is no object which can be dated with safety to the predynastic period or even Dynasties I.-II. Sir Arthur Evans's correlation of Early Minoan III., Middle and Late Minoan, with the Egyptian periods is correct in all essentials, but some modification is required for the correlation of the Cretan Neolithic and Early Minoan I. and II., as the history of Egyptian stone vessels has progressed considerably since the studies upon which he relied. Taking the material from Ur, so far as published, while the technique has some similarity to the most usual form of Egyptian technique—the boring with a stone—none of the vessels reported from Ur is of Egyptian origin, and they serve no useful purpose in the correlation of the early Sumerian and Egyptian periods.

The Development of the Thyroid.—Ernst Marcus (*Die Naturwiss.*, 27, Feb. 1931) gives a brief account of the development of the thyroid glands in Amphibia, based on his two recent papers on this subject in *Zool. Jahrb.* (Anat. Ontog. 52, Allg. Zool. u. Physiol. 49). Investigation of the ingrowing nervous layer of the ectoderm in all three orders of Amphibia—Gymnophiona, Urodela, and Anura—shows that the thyroid arises from this layer without participation of the endoderm. Implantation of oral ectoderm and mesoderm in the ventral region of the young larva results in the development there of thyroid; the turning of the presumptive oral ectoderm through 180° results in the development of a thyroid lying dorsal to the gut. If a piece of ectoderm the dorsal margin of which borders the ventral half of the presumptive oral region be turned, the portion of the nervous layer which remains in its natural position gives rise to a normal thyroid directed obliquely ventrally away from the endoderm of the gut, while the other portion of the nervous layer produces a thyroid directed obliquely dorsally and without relation to the endoderm.

Axolotls in Captivity.—Number 8, volume 4, of the *Aquarist and Pond Keeper* (May-June 1931) includes several references to the axolotl. In "Notes from the Brighton Aquarium", Mr. George W. Weller describes both black and white varieties. In the "Readers' Records", Mr. John Gray notes that an axolotl had tried to eat a stickleback, which choked and killed it; and Mr. W. E. Teschemaker makes the very interesting statement that a pair of axolotls living in an out-of-door pond have spawned and that the eggs are on the point of hatching. The parents have found their own food since last May, when they were first placed in the pond. The same observer has already reared the young axolotls in the open from the age of about six weeks or less, so that it is quite possible for the whole of the breeding and rearing to take place out of doors at low temperatures.

The Great Crossbill Movement of 1927.—In the summer and autumn of 1927, as many records in the British Isles witnessed, there occurred an important migration of crossbills (*Loxia curvirostra*). The movement, summarised by Ad. S. Jensen, extended over the greater part of Europe from mid-Russia to western France, Ireland, and Iceland, from Finmark to mid-Italy and the Ukraine, and even to the southern parts of western Siberia (*Det Kgl. Danske Vidensk. Selsk., Biol. Meddel.*, 10, 1, 1930). It was noticeable that the crossbills showed themselves earliest in the most easterly countries visited and progressively moved westwards. The origin of the flight, therefore, must be sought in the east, indeed in the northern parts of Russia and Siberia, where the great pine forests form the particular habitat of these birds. When explaining the migration, it must be remembered that in the summer of 1927 the pine-trees in these parts made extremely poor growth and the pine seed harvest was a failure, so that the crossbills, deprived of their staple food, were compelled to wander to fresh feeding-grounds.

Biological Control in Mauritius.—Mauritius, like many other sugar cane growing countries of the world, suffers severely from the ravages of Lamellicorn beetle larvæ. The species *Phytalus smithi* appears to have been accidentally imported into Mauritius from Barbados, some time prior to 1911, when it was first recorded as a pest. Good work has been achieved by various artificial methods of control, and this has been augmented by the application of biological measures. In 1916, the solitary wasp, *Tiphia parallela*, was introduced from Barbados and has now become well distributed over the whole region of infested cane. The present day position of the problem is described by Mr. D. d'Emmerez de Charmoy, in the issue of the *Bulletin of Entomological Research* for March. He points out that since the *Phytalus* has been well established in Mauritius, some twelve or fifteen years before the introduction of its parasite the latter is, for the time being, at a disadvantage from the economic point of view. Years must elapse before it can increase to the point where it will exterminate a sufficient proportion of the host population to yield the desired degree of control. At present the *Tiphia* destroys up to 30 per cent of the *Phytalus* and its work is being augmented by a second parasite, *Elis thoracica*, which was imported from Madagascar in 1917. At the present juncture, it may be said that artificial measures of control are required to be rigidly prosecuted so long as the biological method remains only very partially efficacious.

Tea in India.—Dr. Harold H. Mann's lecture, published in the *Journal of the Royal Society of Arts* of April 3, upon the scientific aspects of the Indian tea industry, was an interesting historical résumé, by one qualified to speak, of the progress in tea cultivation under Indian conditions. Dr. Mann went to India in

1900 as the first scientific officer of the Indian Tea Association When tea plants were first cultivated in India, early in the nineteenth century, plants were introduced from China, but the discovery of indigenous tea plants on the borders of India and in Assam directed attention to the suitability of certain districts, especially Assam, for tea cultivation, and in 1839 the Assam Company was floated to take over and extend two-thirds of the Government plantations in the province In those days, only Chinese experience and Chinese methods of cultivation were available, and Dr Mann suggests that the Indian industry has only thrived since it has been broken away from these methods and developed its own Tea is a crop with special requirements, it thrives on acid soils and deteriorates upon liming, the crop required is not flower or fruit, but the young leaf, so that a special pruning and cropping technique is required in order to encourage the continual succession of young leafy shoots suitable for plucking

Flora of Lancetilla Valley, Honduras —In compiling an enumeration of lowland Honduran plants of the region about Lancetilla Valley and the port of Tela, P C Standley (Field Museum of Natural History, *Botanical Series*, vol 10, Publication 283, Jan 1931) has made available a botanical work which will be equally useful for study purposes anywhere in the lowlands of Central America, as the area is typical of the wet lowlands of the whole Atlantic coast of that country Almost all the area which is not devoted to the cultivation of bananas, which is the principal industry and furnishes the chief article of export from Honduras, is covered by dense forests, wooded swamps, or marshes A general botanical description of the different types of vegetation, with accounts of the climate, geography and inhabitants, economic plants of the district, the relationships of the flora, vernacular names, and previous botanical exploration of the region, precede the descriptive flora Both flowering plants and cryptogams are included, though the list of the latter is very incomplete Many of the commoner plants are well illustrated

Permian Insects —In part 13 of his series of papers on "Kansas Permian Insects", Dr R J Tillyard (*Amer Jour Sci*, 21, p 232, 1931) deals with a small group which at first sight appear to be true Coleoptera (or beetles), but a study of the venation and method of folding of the hind wing shows that there is no close relationship between these two groups For these Permian insects Dr Tillyard proposes a new order, the Protelytroptera, which he regards as the ancestral group from which the existing Dermaptera (or earwigs) have been derived

Fossils of the Upper Rhine Valley —W Salomon-Calvi ("Oberrheinischer Fossilkatalog," Lief 1, Berlin Gebrüder Borntraeger, 1931, 35 gold marks) has edited a catalogue of the fossils found in the upper Rhine valley extending from Basel in the south to Hunsrück and the Taunus in the north Under each species references are given to the works in which it is recorded or described, to the locality and horizon, and to the museum in which specimens may be seen The part now published is divided into five sections 1, "Palæozoic Animals" by M Pfannenstiel, 2, "Triassic Vertebrates" by W Scheffen, 3, "Jurassic Invertebrates" by W Deecke, 4, "Triassic and Jurassic Vertebrates" by M Pfannenstiel, 5, 'Palæozoic and Mesozoic Plants" by K Frentzen.

Ionic Wind Voltmeter —One of the earliest effects noticed when a pointed conductor was connected with a source of high voltage was the electric wind produced at the point The wind is produced by the ions colliding with the uncharged molecules and giving them velocities The effect is observed at both the high tension and the earthed pole When the latter is enclosed in an insulating vessel and a bent wire is used as an electrode, it is found that the wire is cooled by the alternating component of the wind according to definite laws This phenomenon is used in the ionic wind voltmeter described by Prof W M Thornton, W Waters, and W G Thompson in the *Journal of the Institution of Electrical Engineers* for April By making the earthed electrode part of a hot wire, bridge readings are obtained from which the voltages can be determined The readings are due to the applied field upsetting the balance of the bridge Indoor forms of voltmeters are made to indicate up to 300 kilovolts, and outdoor forms up to 132 kilovolts In addition, portable forms from 3 to 150 kilovolts are made for general testing and X-ray work The authors describe also a thermo-electrostatic relay which should prove a help in maintaining uniformity of voltage on the grid, a problem of considerable importance in distribution If a fault or an excess load causes the line voltage to vary, the device actuates a warning signal The authors state that the researches they made during their investigation on electrical discharge of gases have disclosed a new method of comparing molecular ionising potentials

Fibre Structure —An illustrated pamphlet of eighteen pages, issued by the University of Leeds, gives an account of the research work done there during the session 1929-30 with the aid of a grant from the Cloth workers' Company It includes a five page summary of the advances in our knowledge of the atomic structure of fibres by the X-ray analysis work of Messrs W T Astbury and H J Woods Wool in its natural state is built up of a number of molecular chains folded into a series of hexagons, and when the wool is stretched these hexagons break up into long zigzag lines the length of which may be double that of the series of hexagons On the withdrawal of the stretching force, the original hexagonal form is resumed Natural silk, on the other hand, behaves as would wool already stretched, and has not the long range elastic properties of natural wool While steam has little effect on the properties of natural wool, it deprives stretched wool of its elasticity, and when the stretching force is removed the wool remains set in the extended state This fact has important bearings on the dyeing and conditioning of wool and on other textile processes The Government Grant Committee of the Royal Society granted £200 last year for the furtherance of these researches

Rotation of Molecules in Crystals —It has been suggested that in many cases there may be complete rotation of the molecules in crystals at temperatures below the melting point, and the transitions involving considerable absorptions of heat which have been found for solid hydrogen halides may be explained as due to the taking up of rotational energy by the molecules The transition of solid hydrogen chloride is perfectly isothermal at 98 36° abs and requires 284 3 cal per mol This explanation would require that the solids should have high dielectric constants, and for hydrogen chloride, for example, the dielectric constant of the solid should increase considerably at 98 36° abs Cone, Denison, and Kemp, in the April number of the *Journal of the American Chemical Society*, show that this is the case A temperature range of 85° to 165° abs was used At 98 4° abs the dielectric constant changes isothermally from 3 to 10 Thus the theory of the rotation of the molecules in the crystal is supported

The Ross Institute and Hospital for Tropical Diseases

THE twenty fifth anniversary in 1923 of Sir Ronald Ross's epoch making discovery of the transmission of human malaria through the bite of anopheline mosquitoes was the occasion of an appeal for the foundation of an institute for research upon, and for the treatment of, tropical diseases which should serve as a lasting monument to Ross's achievement

As a result of this appeal, initiated by Sir William Simpson and Sir Aldo Castellani and supported by many influential signatories in all parts of the world, funds were contributed by Indian princes, colonial governments and municipalities, city companies, rubber, tea, oil, and other trading companies, and private individuals a house and grounds were acquired on Putney Heath, London, and the building was adapted partly as a hospital for the treatment of patients suffering from tropical diseases and partly as laboratories for research This constitutes the present Ross Institute and Hospital for Tropical Diseases, of which Her Grace the Duchess of Portland is president

The Institute is administered by a council of which Sir Charles Campbell McLeod is chairman and Major Lockwood Stevens, secretary The staff includes Sir Ronald Ross himself as director in chief, Sir William Simpson, director of tropical hygiene, and Sir Aldo Castellani, medical director, with Sir Malcolm Watson in charge of the Malaria Department The annual Report for 1930, recently issued, surveys at some length the activities and research work of the Institute An increased number of patients were treated in the hospital during the year, the total number being 85

Sir Ronald Ross has continued to write upon malaria and its control, Sir William Simpson is investigating the longevity of the plague and other bacteria, and Sir Aldo Castellani has published several papers on minor and other ailments of the tropics and upon fungi which attack the skin Dr Shaw Mackenzie is continuing his studies of the blood changes that occur in cancer and on the diagnosis by blood tests and treatment of this disease In the malaria laboratory, observations have been made on the influence of cold upon the larvæ of the British tree breeding anopheline, *A plumbeus*, showing that they hibernate and resist even freezing in the water in the tree-holes A lengthy survey is given of the activities of the Anti Malaria Advisory Committee of the Institute in the control of mosquitoes and malaria abroad, this work was referred to in NATURE of Jan 31 p 173

Courses of instruction have been given to planters and others interested in the control of malaria Unfortunately, the income for the year shows a decrease of £1500, partially counterbalanced by a reduction in expenditure of £628 on 1929 The financial position of the Ross Institute is unsatisfactory, as at present the Institute is entirely dependent upon voluntary contributions, and an appeal is made for funds to create an endowment fund

In a series of appendices, the malaria policy of the Ross Institute is outlined and the results of malaria preventive measures summarised Mr Jackson Clarke, a veteran worker in cancer research, is arranging his collection of slides and photographs for exhibition in the laboratories

Bi-Centenary of the Foundation of the Royal Dublin Society

THE bi centenary of the Royal Dublin Society will be celebrated in Dublin on June 23–26 The history of the Society is in many respects remarkable As regards the scope of its activities it is probably unique The first meeting of the Society was held on June 25, 1731, in the rooms of the Philosophical Society in Trinity College, Dublin The earliest definition of its objects is expressed as follows

"It was proposed and unanimously agreed unto, to form a Society, by the name of the Dublin Society, for improving Husbandry, Manufactures and other useful arts"

A few days later, on July 1 at the second meeting, it was agreed that the words "and sciences" should be added after "arts" in the title of the Society

Among its earliest members the name of Thomas Prior appears He had graduated in Trinity College, Dublin, in 1703 He acted as secretary of the young Society for twenty years, and is by many regarded as its founder Several distinguished names appear as early members among others, that of Dr John Madden, whose son, Samuel Madden, D D, became a member in 1733 and proved to be one of its most loyal, able, and generous supporters He became known as 'Premium Madden' because of his wise policy of offering premiums for methods of tillage, etc He was influential in obtaining for the young Society its first charter

Among the earliest members many other noteworthy names appear, including that of Sir Thomas Molyneux, a fellow of the Royal Society, who was a friend of Robert Boyle, of Sir William Petty, of Newton, Evelyn, Dryden, and Locke Molyneux's scientific interests were wide, he first gave a rational account of the origin of the Giants' Causeway, and wrote a scientific report on the Irish elk In general, however, matters of a practical character engaged the attention of the young Society such as Prior's paper on 'A New Method of Draining Marshy and Boggy Lands"

The foundation of local branch societies in the principal towns and cities of Ireland, which should establish communication with the Dublin Society, was promoted There is no doubt as to the practical and directly beneficent character of the work of the young Society, and, at the same time, of its interest in the promotion of applied and general science

This was in the days of that brilliant but unhappy genius, Jonathan Swift A very extraordinary anonymous book, printed in Dublin in 1753, and written "By a Friend to the Peace and Prosperity of Ireland", is in the possession of the present writer It purports to be "A Dialogue between Dean Swift and Thos Prior, Esq, in the Isles of St Patrick's Church, Dublin, Oct 9, 1753" The shades of the two defunct speakers, rising at midnight from the grave, discuss the economic conditions of Ireland and how best they can be improved The constructive ambitions of Prior are in general exposed to the caustic satire and pessimism of the Dean But in the end both agree on the necessity of reforms The dialogue, covering 134 pages, is brilliant throughout

In the first century of the Society's existence, systematic works, not only of economic and practical nature, but also in many cases of considerable scientific interest, were published by the Society The now well known 'Spring Shows' of the Society were inaugurated in 1831, and the stated meetings of the scientific members of the Society began some three years later

It has been said that most of the good which has been done for Ireland has been done by this great

institution To its initiative and labours Dublin owes its beautiful Botanic Gardens at Glasnevin, its Museum of Art and Natural Science, its National Gallery and School of Art, its National Library, and its College of Science now amalgamated with the National University The Irish Fishery Department is largely due to its initiative and early support Its great agricultural shows and horse shows are known over the world

More recently, the Irish Radium Institute came into existence as one branch of the Society's beneficent work Its fine pioneer work in advancing radio therapy, mainly due to the late Dr Walter Stevenson, is widely known The functions of this Institute extend to all parts of Ireland

The support of science, pure and applied, in all its branches has been one of the Society's principal functions in recent years Its *Transactions* and *Proceedings* include some of the most important writings of Fitzgerald, Stoney, Preston, Trouton among others The Society supports a liberal fund for the prosecution of research by the purchase of scientific instruments which are supplied on loan to the investigator, or by money grants when a hopeful investigation is involved In its great hall, seating 1600 persons, scientific lectures suited to a youthful audience or, again, to an audience of adults are delivered annually by recognised scientific authorities Still more advanced lectures and demonstrations are delivered periodically in a smaller apartment

From remote times the Society has promoted the fine arts, as already mentioned, and offers to young artists annually a valuable prize upon the result of competitive work The prize is of sufficient value to enable the winner to go abroad for the study of art, if he so desires Nor has the cultivation of music been neglected Throughout each session eminent musicians perform for the benefit of the members and of the general public

The membership of the Society to-day numbers 9000, and a long waiting list exists The great educational value of its membership is recognised by all

In the celebration of its two hundredth birthday, every effort will be made to recall its earlier history, as well as to show by contrast the advance between then and now Early scientific instruments of historic value will be shown Recent instruments for research devised by members of the Society will be on view Works of art from Irish painters or sculptors which have arisen out of the Art School long ago established by the Society will be brought together A period ball on June 26 will close the celebrations In this, efforts to reproduce the costumes of the past will be encouraged

June 23 is the opening day A conversazione, and reception by the president, will be held on the evening of that day

The North Sea Earthquake.

LATER reports on the North Sea earthquake of June 7 add little, if anything, to our knowledge of its distribution Several of the cracks in the Chapter House of Lincoln Cathedral were found to be widened, and the shock was felt so far to the south as Paris The former city lies within the area of slight damage as previously traced, the latter within the boundary of the disturbed area The course of that boundary towards the east and north remains uncertain, in the absence of records from western Germany and Denmark

An unusual feature of the earthquake is the great extent of the sound area In Great Britain, the sound was heard at several places not more than fifty miles within the boundary of the disturbed area The double nature of the shock was also observed over a wide area, and even at places so near the boundary as Elgin and Bristol

It is remarkable that some of the earthquakes most widely felt in Britain should be of submarine origin The earthquake of 1852—the only one felt in all four divisions of the British Isles—disturbed an area of not less than 56,000 sq miles The exact position of the epicentre is unknown, but it was probably submarine and not far from the coast of Ireland The shock so generally felt in eastern Scotland four years ago was connected with a centre to the west of the Norwegian coast A centre lying a few miles east of Jersey has been responsible for several shocks felt over the south of England and even in London The disturbed areas of the Jersey earthquakes of 1878 and 1889 contained about 68,000 sq miles, while that of the earthquake of 1926 cannot have been much less

So far as we know the focus of the recent North Sea earthquake has not been in action for several centuries The injury to the Chapter House at Lincoln suggests, however, that a strong earthquake in the year 1185 may have been connected with the same centre The shock is briefly described in several monastic and other chronicles According to Holinshed ("Chronicles", vol 2, pp 188 189), "On the mondaie in the weeke before Easter, chanced a sore earthquake through all the parts of this land, such a one as the like had not beene heard of in England sithens the beginning of the world For stones that laie couched fast in the earth, were remooued out of their places, stone houses were overthrowne, and the great church of Lincolne was rent from the top downwards"

C DAVISON

University and Educational Intelligence

CAMBRIDGE—Dr S Goldstein, of St John's College, and Mr J M Whittaker, of Pembroke College, have been appointed University lecturers in the Faculty of Mathematics

Dr N J J M Needham, of Gonville and Caius College, has been reappointed University demonstrator in biochemistry

The Appointments Committee of the Faculty of Biology 'B' invite candidates for the post of University demonstrator in experimental psychology to send in their names to Prof Bartlett (at the Psychological Laboratory), together with such evidence of their qualifications as they think fit, not later than Oct 1, 1931 An appointment will be made early in the Michaelmas Term 1931 The salary of the demonstrator will be £160 per annum

The Benn W Levy research studentship in biochemistry is vacant Applications for its tenure should be addressed to Sir F G Hopkins at the School of Biochemistry, before July 1

The title of Professor Emeritus has been conferred on Sir R H Biffen upon his retirement from the professorship of agricultural botany

The General Board has been authorised to re-appoint Sir Horace Lamb, of Trinity College, to the Rayleigh lectureship in mathematics

The Vice Chancellor, Prof Seward, Master of Downing College, T Knox Shaw, of Sidney Sussex, Prof Debenham, C F Cooper, of Trinity Hall, Sir E H Young, of Trinity College, J M Wordie, of St John's College, and R E Priestley, of Clare College, have been appointed a Syndicate to prepare a scheme for the erection of a building for the Scott Polar Research Institute

Prof G H Hardy, Savilian professor of geometry

in the University of Oxford, has been elected to the Sadleirian professorship of pure mathematics, in succession to Prof E W Hobson, who has resigned

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Applications are invited by the Director of Agriculture, Punjab, for the Maynard Ganga Ram Prize of the value of 3000 rupees, which will be awarded for a discovery, or an invention, or a new practical method tending to increase agricultural production in the Punjab on a paying basis Applications must reach the Director of Agriculture, Punjab, Lahore, by, at latest, Dec 31, 1932

The Council of the Institution of Electrical Engineers offers a Ferranti Scholarship of the annual value of £250 and tenable for two years, for whole time research or post graduate work Candidates must be less than twenty six years of age, and nominations must be received by Aug 15 Particulars of these scholarships can be obtained from the Secretary of the Institution, Savoy Place, London, W C 2

The following have been appointed to Commonwealth Fund fellowships tenable by candidates from the British Dominions Mr Ernest Beaglehole (New Zealand and London) to Yale University, in psychology, Mr N S Grace (Saskatchewan and London) to the University of California, in chemistry, Mr Bernard Notcutt (Stellenbosch and Oxford) to the University of California, in philosophy The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas Mr T G G Beck (Public Works Department, Government of New Zealand) to the University of California, in civil engineering, Mr B J Dippenaar (Department of Agriculture, Union of South Africa) to the University of Wisconsin, in agriculture, Mr A R B Edgecombe (Public Works Department, Government of India) to the University of California, in electrical engineering, Mr H R Knowles (Department of Agriculture, Union of South Africa) to the University of Wisconsin, in agriculture, Mr E H Samuel (Civil Service, Government of Palestine) to Columbia University, in economics, Mr George Stark (Native Development Department, Government of Southern Rhodesia) to the University of North Carolina, in education

In the Report for the year 1929–30 of the University of Leeds, prominence is given to the development, actual and prospective, of the University's residential accommodation for students Devonshire Hall, begun in 1928, already accommodates 140 men and is one of the largest hostels in a modern university The plans of the building make provision for further expansion, but the extent to which this shall take place will depend not only on funds becoming available but also on the solution of the problem of how many students can appropriately be associated within a single hostel Another important addition to the University's buildings is the mining block, finished during the summer Here accommodation is reserved for members of the scientific staff of the Department of Scientific and Industrial Research engaged on a chemical and physical survey of the coal resources of West Yorkshire, which is part of a survey of the coal resources of Great Britain being carried out by the Government Statistical tables annexed to the report show a substantial increase in the number of day students, both full time (from 1385 to 1434) and part-time (from 144 to 219) Evening classes, chiefly textile and fuel (industrial) show a falling off from 223 to 144

Birthdays and Research Centres.

June 20, 1861.—Prof Sir F G Hopkins, Pres R S, Sir William Dunn professor of biochemistry in the University of Cambridge.

My department is engaged upon a variety of biochemical problems, but of late years we have given the most attention to a study of the catalytic control of biochemical reactions and especially of oxidations in the living cell We are endeavouring to apply such studies widely in the biological field, not to mammalian tissues alone, but to every form of living cell I think that very significant knowledge can be won by studying the metabolism of living organisms, not a little has come to light as the result of work by my colleagues in Cambridge

I have myself returned lately to a study of the functions of glutathione in tissue respiration, and find that, in some tissues at any rate, it plays a real part in the organisation of events I am also following up certain lines of vitamin research

June 22, 1864—Sir Daniel Hall, K C B, F R S, Chief Scientific Adviser, Ministry of Agriculture and Fisheries, and Director of John Innes Horticultural Institution

So far as my personal work is concerned, I am endeavouring to clear up certain points in the taxonomy of tulip species, which has taken on a new aspect since the discovery of polyploidy in the genus by the late Mr W C F Newton Tulips present various other problems of great significance in general botanical theory, but they can be resolved only by breeding experiments Since six years are required on the average to bring a tulip seed to the flowering stage and two or three generations are necessary, I am trusting to some successor eventually to work out the material I am initiating

Herein lies the great value of a research foundation like the John Innes Horticultural Institution, it can embark with some confidence upon a scheme of work that may require a long term of years for its completion The genetics of fruit trees affords a case in point, a generation is rarely less than seven years with apples, plums, and cherries, and although Mr Crane has already obtained results of prime importance, they still open up fresh vistas of more extended work

Considering the magnitude of British interests in the tropics and the fact that all progress in the improvement of tropical crops like copra, rubber, tea, coffee, etc, depends upon genetical work, it is lamentable to see how little recognition the subject still receives either in our universities at home or in our experimental stations overseas

June 22, 1887—Prof Julian Huxley, honorary lecturer in zoology at King's College, London

I am myself especially interested in various lines of work bearing directly or indirectly upon the relation of hereditary constitution to adult characters such problems as the effects of individual genes during development, the study of changes in relative size of organs with growth, and the systematic study of gene-expression under different environmental conditions

I am also much interested in the species problem, and wish that a concerted attack could be directed upon it by a team including general zoologists as well as systematists, students of distribution, ecologists, biometricians, and geneticists I believe that a careful organisation of research in this field would be extremely fruitful

June 23, 1859 —Lieut -Col A W ALCOCK, C I E, F R S, I M S (retired), formerly professor of medical zoology in the University of London

Since my retirement from the London School of Tropical Medicine under the statutory age-limit, my efforts have been confined to supporting, under the auspices of the Tropical Diseases Bureau, what I hope may never be neglected, namely, the old and fruitful connexion between natural science and scientific medicine Authors of papers treating of animals specifically hurtful to the human frame, and zoological papers throwing light on causes, or suggesting means of control and prevention, of specific diseases of mankind, provide most of the material of this useful though non spectacular work

As a medico zoological subject for extremely promising study, I would direct attention to the wolf-reared children—one of whom I have seen—that occasionally come to light in northern India There is evidence that such children, having in infancy been carried off by wolves, have survived, have lived among the wolves, and (if by after chance rescued by capture) behave as wild animals But to what extent the germs of their human and intellectual endowment have been annulled or aborted in their aberrant wolfish environment is a subject that has never been precisely investigated It is plain that such exact investigation by a company of medical mentalists and biologists might be enormously instructive, in many directions, where confusion and fallacy now are somewhat prevalent

June 25, 1859 —Prof SYDNEY J HICKSON, F R S, emeritus professor of zoology in the University of Manchester, honorary fellow of Downing College, Cambridge

During the last three years the subject of my investigation has been the species problem in certain groups of Cœlenterata With this in view, I have completed a study of the Gorgonacea from the Panama region and of the Xeniidæ from the Barrier Reef In some genera there are apparently clearly defined discontinuous groups probably of the character of Linnean species, in others there seems to be complete continuity between the so called 'species' Satisfactory results as regards continuity can only be obtained when considerable numbers of specimens of a genus from one locality, or of species from several localities, are submitted to detailed investigation

The main object of this research is to throw light on the origin of species in a group of radially symmetrical and sedentary animals

June 26, 1894 —Prof P KAPITZA, F R S, fellow of Trinity College, Cambridge, and assistant director of magnetic research in the Cavendish Laboratory

The general line of our research is the study of the influence of strong magnetic fields on solid substances It is possible to trace the influence of the magnetic field on nearly all the known physical properties of substances We devote our attention mainly to studying the magnetisation of the substance itself, to the influence of the magnetic field on the binding forces between the atoms (magnetostriction) and to the disturbing effect of the field on the motion of free electrons in the crystal lattice (galvanomagnetic phenomena)

It appears that all these phenomena are strongly influenced by the physical state of the substance, and are much simplified if they are studied in undisturbed crystals The presence of foreign atoms, plastic deformation, and temperature agitation all seem to disturb the symmetry of the crystal lattice and hinder the appearance of the more simple laws which govern the phenomena in a perfect crystal lattice Should these laws be established they would probably have a more simple theoretical interpretation, since the crystal lattice is the most regular and symmetrical of all aggregates of atoms known in Nature

Societies and Academies.

LONDON

Royal Society, June 11 —**M L E Oliphant** Electron emission from Langmuir probes and from the cathode of the glow discharge through gases It is found that for potentials above about 600 volts the rate of increase of current to the probe is greater than that predicted by the original theory of Langmuir and Mott Smith, and this is ascribed to electron emission from the electrode, which increases with the energy of impact of the positive ions The energy delivered to the probes as heat has been measured by a compensation method which eliminates all corrections. From this energy and the potential of the probe relative to the surrounding space the positive ion current i_p can be obtained It is found that the ratio of electron to positive ion current is independent of the energy of the positive ions up to that corresponding to a potential of 600 volts, and thereafter increases The results are then discussed from the point of view of the angle of impact of the positive ions on the electrode surface, and it is pointed out that there must be an emission of electrons produced by agencies other than the impact of positive ions —**H E Watson, G Gundu Rao, and K L Ramaswamy** The dielectric coefficients of gases, I The dielectric coefficients of the five inactive gases and hydrogen have been measured at 25° and at − 190° or − 78° and compared with that of carbon dioxide None of these gases except argon has an electric moment detectable by the method of measurement employed, $0\ 05 \times 10^{-18}$ being an upper limit for krypton and xenon For argon the figure appears to be $0\ 03 \times 10^{-18}$, but this is probably a spurious result For the remaining gases it is not more than $0\ 015 \times 10^{-18}$ Further investigations of possible sources of error have been made, and an approximate method of determining condenser distortion with pressure is described —**G D Bengough, A R Lee, and F Wormell** The theory of *metallic corrosion, IV The effect on the corrosion of zinc of faster and slower rates of oxygen supply* than those used for previous papers has been studied, and some comparisons made with the corrosion of mild steel Complete curves are given showing the effect of concentration of potassium chloride and of potassium sulphate on the corrosion rates of zinc in tranquil conditions The influence of depth of immersion between limits of 0 35 mm and 100 mm has been ascertained An explanation has been found for the departure from linear corrosion rates after prolonged immersion in potassium chloride solution A micrographic study of the form and distribution of corroded areas has shown that very highly purified zinc yielded characteristic etch pits, but no preferential crystal boundary attack, less highly purified zinc rarely showed etch pits of definite shape, but marked preferential attack on the crystal boundaries

Geological Society, May 20 —**A A Fitch** The geology of the country between Ivybridge and Buckfastleigh, Devon The area described consists of a strip of the granite margin, the metamorphic aureole, and some rocks beyond the influence of the granite The physical geology is discussed and the presence of a relic of the 700–500 foot platform demonstrated by

planimetric measurements The rocks are described stratigraphically The petrology and petrogenesis of the resulting rocks are discussed in detail, and some aspects of two way migration considered The mineral assemblage of the aureole is not of much diagnostic value for the provenance of the sediments of the South of England Superficial deposits do not afford matter of great interest Economic aspects of the geology are dealt with

DUBLIN

Royal Irish Academy, May 11 —**J J Nolan** and **P J Nolan** Observations on atmospheric ionisation at Glencree, Co Wicklow The equilibrium of atmospheric ionisation was examined under conditions of wide variability of concentrations of condensation nuclei Certain diurnal variations of the concentrations of ions and nuclei were found The relation between ions and nuclei cannot be represented by a recombination equation of the ordinary type An empirical equation formerly proposed, involving the square root of the nucleus concentration, appears to fit the results better Both the ratio of positive to negative ions and the rate of production of ions appear to have a diurnal variation corresponding to that of the earth's field —**T McHugh** A pair of circular cubics generated by two rigid quadrangles When one plane moves upon another in such a way that a fixed quadrangle in the first plane is always in perspective with a fixed quadrangle in the second plane, the centre of perspective describes a circular cubic in each plane The relations and properties of these cubics are discussed and degenerate cases are examined

EDINBURGH

Royal Society, May 19 —**A D Peacock** and **R A R Gresson** Male haploidy and female diploidy in *Sirex Cyaneus*, F (Hymen) The work of Peacock and Sanderson on the more generalised Hymenoptera, the Tenthredinidæ, in which cells of connective tissue, blastoderm, embryo, and gonad have been examined, shows that the parthenogenetically produced male is haploid (8) and the bi sexually produced female is diploid (16) Further work, by Peacock and Gresson, on the wood wasp *Sirex cyaneus* F, supports the same view, for the spermatogonia and second spermatocytes are haploid (8), there is an abortive first maturation division, and the oogenia are diploid (16) Shortage of material has precluded study of the somatic cells Fuelgen's 'nuclealreaktion' is negative when applied to the large chromoid body and the cytoplasmic granules seen so prominently in spermatogenesis by the iron hæmatoxylin technique, their nature remains to be discovered —**Jessie A R Wilson** Some new facts about the structure of the cuticles in the Russian paper coal, and their bearing on the systematic position of some fossil Lycopodiales With a note on the absence of eligulate heterosporous Lycopodiales in the fossil record by **J Walton** A reinvestigation of the plant-cuticles extracted from the 'paper coal' from the Lower Carboniferous of the Moscow Basin has confirmed that the plants from which these cuticles have been derived were in possession of a ligule and must be classed amongst the ligulate lycopods Since there is no evidence of leaf cushions having been present on the older stems the cuticles are to be referred to the genus *Bothrodendron* A critical consideration of the known facts about the living and extinct Lycopodiales makes it clear that there are no known examples of eligulate heterosporous types —**A H R Goldie** The electric field in terrestrial magnetic storms Magnetically disturbed days magnify a peculiarity that is present in the diurnal variation of magnetic force even on quiet days, the magnification increasing with proximity to the auroral zone Using mainly the data of Lerwick, Eskdalemuir, and Abinger observatories, computations are made of the position, direction, and strength of electric currents capable of producing the displacements recorded during storms The heights found in individual cases range from less than 100 km to above 500 km, strengths are of the order of 500,000 amperes Midwinter and quiet years are characterised by currents low in strength and in altitude and considerably inclined to the W-E direction, summer and equinoctial seasons and disturbed years by the opposite features A chart is given of the electric current system in northern latitudes This system is derivable from currents generated mainly in the illuminated regions of the globe —**T M MacRobert** Fourier integrals This paper gives proofs, by the method of contour integration, of Fourier's double integral and of the Fourier-Bessel integral Two new Fourier Bessel integrals are then established, and also a Fourier-Legendre integral

PARIS

Academy of Sciences, April 27 —**Gabriel Bertrand** and **V Ciurea** Lead in the organs of animals In a previous communication regarding the occurrence and distribution of tin in animals it was mentioned that the sulphide precipitate contained other metals besides tin One of these is lead, and figures are now given for the amounts of lead found in various organs of the ox, horse, and sheep Generally, the distribution of lead and tin in the organs of these animals is similar, except in the case of the brain, which, in proportion, contains more lead —**L Cayeux** The core in core structure in schists Of the two hypotheses suggested for the explanation of the core in core structure, crystallisation and a pressure effect, the latter is found to accord best with the results obtained by the author from his examination of the Ordovician schists of Cabrières —**Ch Achard** and **M Piettre** The proteins of the articular effusion —**Paul Helbronner** A text of the third circular letter of Pascal relating to the cycloid (Dec 7 and 9, 1658) —**S Winogradsky** New researches on the micro-organisms of nitrification a description of a modified silica gel culture method, in which the gel is coated with a layer of an insoluble carbonate of an alkaline earth, the production of nitrate is accompanied by solution of the carbonate and consequent formation of translucent spots which can be counted —**A Buhl** The curvilinear propagation of invariant integrals The case of double integrals Corpuscular propagation —**D Wolkowitsch** The utilisation of Culmann's ellipsoid of inertia for the representation of an empirical law by an approximate formula with several parameters —**André Fouillade** A general theorem of iteration —**Arnaud Denjoy** Co-ordinated ensembles —**Paul Montel** Pairs of polynomials the zeros of which are inter related —**Edgar Baticle** The equilibrium curves of wires the elements of which are submitted to central forces —**P Dupin** and **Teissié-Solier** The alternate vortices of Bénard Karman and Reynolds's law of dynamical similitude —**S Choubine** The possible anomalies of resistance at low temperatures —**L Goldstein** The quantic mechanics of atomic shocks —**Drzewiecki** The application of Bernoulli's formula to the expansion of gases —**R Perrin** and **V Sorrel** An induction furnace with a ferromagnetic muffle and self-regulating temperature The muffle is made of ferrocobalt (30 per cent cobalt) and is surrounded by a closed conducting envelope (nickel) not magnetic at the working temperature With currents varying from 40 amp to 120 amp the temperatures varied only from 946° C to 972° C. The range of

special steels now available permits self regulating furnaces of this type to be made to work at any temperature between 150° C and 1100° C —**A Sesmat** The hypothesis of the curve of pursuit and Michelson's experiment —**A. Kastler** The structure of the Raman bands in liquids In the passage from the gaseous to the liquid state, the Raman bands are displaced in the direction of lower frequencies —**Ch Féry and Reynaud-Bonin** A non sulphating accumulator with high output A modification of the arrangement suggested in 1924, in which the access of oxygen to the negative plate is prevented The results of comparative tests on the commercial scale with ordinary and modified accumulators are given, and show clearly the advantages possessed by the latter —**P Brenans and K Yeu** Symmetrical halogenated phenols —**M G Filipesco** The siliceous rocks of organic and chemical origin from the Oligocene of the Carpathian mountains —**Albert Michel-Lévy** The conditions of deposit of the Perrier conglomerates (Puy-de-Dôme) —**C Arambourg** The longevity, in northern Africa, of the genus *Rhinoceros* during the Quaternary period Evidence from various sources tends to prove that the rhinoceros survived in North Africa up to a relatively recent date — **Maurice Villaret, L Justin-Besançon, and Jean Camus** The application of perfusion methods to researches of experimental hydrology concerning vaso motricity —**Albert Nodon** Observations on atmospheric detonations preceding solar and terrestrial disturbances —**Ernest Esclangon** Remarks on the preceding communication —**Mlle V Bossuyt and G Chaudron** Contribution to the study of the structure of textile fibres —**Pr Merklen, Mlle E Le Breton, and A Adnot** The influences of the lipoids of serum on the precipitation and estimation of the serum globulins The lipoprotein complexes of the serum exercise a hindering action on the precipitation of the globulins either by carbon dioxide or by neutral salts — **G Tanret** The trehalose of yeast Trehalose is found in high fermentation yeast to the extent of 2 per cent, but is not present in low fermentation yeast —**M A Machebœuf and R Wahl** Biochemical researches on the serum of patients suffering from lipoid nephrosis —**Marcel Labbé and F Nepveux** The sulphydric compounds of human blood in the normal and in pathological states

ROME

Royal National Academy of the Lincei, Nov 16 — **Maria Pastori** General expression for isotropic tensors —**V Hlavatý** Geodetic co ordinates Various considerations concerning Fermi's theorem on the geodetic co ordinates along a curve in *n* dimensional space are discussed —**G Krall** Critical velocities of heavy masses on a binary —**N Sakellariou** A class of central movements —**A Masotti** The electrical condenser formed by a rectilinear wire between two parallel planes The general case, in which the wire is not equidistant from the two planes, is discussed — **R Brunetti and Z Ollano** The Raman effect in pure water and in certain solutions —**V Puntoni** Morphological differentiation of certain species of Actinomycetes confused under the name *Actinomyces bovis* By a study of the process of formation of aerial mycelia, and of the sporification, differential characters have been established between *A sulphureus*, *A albus*, *chromogenus*, *A albido flavus*, and *A carneus* —**M. Mitolo**: The material metabolism of the central nervous system (3) The elimination of the cholesterol The complete elimination of cholesterol by surviving central nervous tissue is a phenomenon which may be established experimentally and is intimately connected with the metabolic processes of the tissue

Official Publications Received.

BRITISH

Forestry Commission. Bulletin No 12 Forest Gardens Pp. 116+25 plates (London H M Stationery Office) 2s 6d net.

The Journal of the Royal Agricultural Society of England Vol. 91 Pp. 8+342+clxxv+12+xvi (London John Murray) 15s

Territory of Papua. The Species of Tobacco grown in New Guinea. By J S L Gilmour (Anthropology, Report No 11) Pp. v+10+7 plates (Port Moresby Government Printer)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol. 69, No 418, May Pp. 557 672+xxviii (London E and F N Spon, Ltd) 10s. 6d

Records of the Botanical Survey of India. Vol 13, No 1 A Census of Indian Mosses, with Analytical Keys to the Genera referred to in the Census as well as all the Genera dealt with in the second edition of Prof Brotherus Account of the Musci Veri in Engler and Prantl's Pflanzenfamilien By P Brühl. Pp. 135 (Calcutta Government of India Central Publication Branch) 2.6 rupees, 4s 3d.

Proceedings of the Society for Psychical Research Part 119, Vol 39, May Pp. 419 447 (London) 2s 6d

The Scientific Proceedings of the Royal Dublin Society Vol 20 (N S.), No 5 Observations on the Photo-electric Measurement of the Radiation from Mercury Vapour Lamps and from the Sun, and on the Effects of such Radiation upon the Skin By Dr W R. G Atkins Pp 49 66 1s 6d Vol. 20 (N S) No 6 Some Experiments on the Accuracy obtainable with Gas filled Photo-electric Cells By Dr W R G Atkins Pp 67 73 6d Vol 20 (N S), No 7 A Method of distinguishing certain Strains of New Zealand Perennial Ryegrass (*Lolium perenne*, L) by examination of Seedlings under Screened Ultraviolet Light By P A Linehan and S P Mercer Pp. 75 83+1 plate 1s (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd)

Board of Trade Report of the Departmental Committee on the Patents and Designs Acts and Practice of the Patent Office (Cmd 3829) Pp 104 (London H M Stationery Office.) 1s 6d. net.

Imperial Institute Annual Report, 1930, by the Director Lieut. General Sir William Furse, to the Board of Governors Pp. 55 (London) 2s

Horticultural Education Association Reports on some Aspects of Horticultural Education Pp. 27 (Lewes.) 6d

The Linen Industry Research Association Report of the Council 1930 Pp 26 (Lambeg)

British Honduras. Report of the Forest Trust, 1929 Pp 15 (Belize Conservator of Forests)

Empire Cotton Growing Corporation Report of the Administrative Council of the Corporation submitted to the Tenth Annual General Meeting on May 20th 1931 Pp ii+94 (London)

Union of South Africa Department of Mines and Industries Geological Survey The Geology of the Country surrounding Nkandhla, Natal an Explanation of Sheet No 109 By Dr Alex L Du Toit. Pp 111+3 plates (Pretoria Government Printing Office) 5s (including Map)

The Committee for Legalising Eugenic Sterilization Psychiatric Indications for Sterilization By Dr Ernst Rüdin (Abridged translation) Pp 10 (London The Eugenics Society) 6d

Report of the Director of the Royal Observatory, Hong Kong for the Year 1930. Pp 19 (Hong Kong)

Survey of India Map Publication and Office Work, 1929 to 1930, from 1st April 1929 to 31st March 1930. Pp vii+19+5 maps (Calcutta.) 1 rupee 1s 9d

Proceedings of the Royal Society of Victoria Vol 43 (New Series), Part 2 Pp 101 262 (Melbourne)

Canada Department of Mines Mines Branch Investigations of Mineral Resources and the Mining Industry, 1929 (No 719) Pp ii+69+5 plates (Ottawa F A Acland)

Proceedings of the Royal Society of Edinburgh Session 1930-1931 Vol 51, Part 1 No 6 The Genus *Lyginorachis* Kidston By Dr R Crookall Pp. 27 34+3 plates. 1s 6d. Vol 51, Part 1, No 7 On Charlier's New Form of the Frequency Function By A C Aitken and A Oppenheim Pp 35 41 9d Vol 51 Part 1 No 8 Some Noteworthy Examples of Parallel Evolution in the Molluscan Faunas of Southeastern Asia and South America By Dr B. Prashad Pp 42 53 1s. Vol 51 Part 1 No 9 The Classification and Development of Carbonaceous Minerals. By Prof Henry Briggs. Pp. 54 63. 1s Vol 51, Part 1, No 10 On the Identity of *Sacculina triangularis* and *Sacculina inflata*. By Dr H Boschma Pp 64 70 9d Vol 51, Part 1 No. 11 Electromagnetic Phenomena in a Uniform Gravitational Field By Dr D Meksyn Pp. 71 79 1s Vol 51, Part 1, No 12 Further Numerical Studies in Algebraic Equations and Matrices By A C Aitken Pp 80-90 1s Vol 51, Part 1 No 13 On the Operational Solution of the Homogeneous Linear Equation of Finite Differences by Generalised Continued Fractions By L M Milne Thomson Pp 91 96. 6d (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd)

FOREIGN

University of Washington Publications in Anthropology Vol 4, No 2 A Sketch of Northern Sahaptin Grammar By Melville Jacobs. Pp 85-291 (Seattle Wash University of Washington Press) 2 dollars

Journal of the Faculty of Agriculture, Hokkaido Imperial University Vol. 30, Part 2 On the Change of Barley Protein in Storage and Germination By Eiji Takahashi and Kihoshi Shirahama Pp 119 161 (Tokyo Maruzen Co. Ltd)

Scientific Papers of the Institute of Physical and Chemical Research No 297 Propagation of Wireless Waves. By Hantaro Nagaoka Pp 169 188 30 sen. No 298 Experimental Studies on Form and Structure of Sparks, Part 3. By Torahiko Terada, Ukitirô Nakaya and Ryûzô Yamamoto Pp 189 217+plates 10-22 90 sen Nos 299 301 X Ray Diffraction by Incandescent Carbon, by Morisô Hirata Über die Bandenspektren des Zinkhydrids, von Mitsuharu Fukuda, An Apparatus for Detecting Defective Insulators, by Takeshi Nishi Pp 219 250+plates 23 24 50 sen (Tôkyô Iwanami Shoten)

Smithsonian Institution United States National Museum. Bulletin 155 The Birds of Haiti and the Dominican Republic By Alexander Wetmore and Bradshaw H Swales Pp iv+483+26 plates (Washington, D C Government Printing Office.) 1 dollar

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 83 The Orthoptera of Kansas By Morgan Hebard Pp 119 227 The Fishes obtained by the De Schauensee South African Expedition, 1930 By Henry W Fowler Pp 233 249 The Grootfontein Southwest Africa, Meteoric Iron By Samuel G Gordon Pp 251 255 The Geographical Forms of *Jolithirax semitorquatus* By W Wedgwood Bowen Pp 257 262 (Philadelphia.)

The American Museum and the University Sixty second Annual Report of the Trustees for the Year 1930 Pp viii+208+8 plates (New York City)

Sudan Government Wellcome Tropical Research Laboratories, Khartoum Report of the Government Chemist for the Year 1930 (Chemical Section, Publication No. 63) Pp iii+32 (Khartoum)

Conseil Permanent International pour l Exploration de la Mer Rapports et procès verbaux des réunions Vol 73 Untersuchungen an Salmoniden mit besonderer Berücksichtigung der Art- und Rassefragen Teil 2 Von H Henking. Pp 122 (Copenhague Andr Fred Høst et fils.) 5 50 kr

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol 82, 1930 Pp 450+37 plates (Philadelphia.) 6 25 dollars

The Academy of Natural Sciences of Philadelphia 1930 Year Book Pp. 77 (Philadelphia.)

Smithsonian Institution United States National Museum Bulletin 154 A Study of the Felid Lizards of the Genus Cnemidophorus with Special Reference to their Phylogenetic Relationships By Charles E Burt Pp. viii+286 (Washington, D C Government Printing Office.) 80 cents

R Osservatorio Astrofisico di Catania. Annuario 1931 Pp iv+87 (Catania.)

Memoirs of the College of Science Kyoto Imperial University Series A Vol 14, No. 2 March Pp 43-78 (Tokyo and Kyoto Maruzen Co , Ltd) 1 00 yen

Anales del Museo Nacional de Historia Natural Bernardino Rivadaria Buenos Aires Tomo 36 Pp. x+519+88 láminas (Buenos Aires.)

Cornell University Agricultural Experiment Station Bulletin 516 Dry Skimmilk in Ice Cream By Walter V Price and Randall Whitaker Pp. 37 Bulletin 517 Celery Production on the Muck Soils of New York. By J E Knott Pp. 37 Bulletin 518 A Statistical Study of Milk Production for the New York Market By M P Catherwood Pp 126 Memoir 135 A Gene in Maize for Supernumerary Cell Divisions following Meiosis By G W Beadle Pp 12+8 plates (Ithaca, N Y)

Carnegie Institution of Washington Publication No 413 Papers from Tortugas Laboratory of Carnegie Institution of Washington, Vol 27 i A Cytological and Biochemical Study of the Ovaries of the Sea urchin *Echinometra lucunter*, by D H Tennent, M S Gardiner and D E Smith ii Observations on the Formation of the Egg of *Echinometra lucunter* by Ruth A. Miller and Helen B Smith, iii Studies on the Coral Reefs of Tutuila, American Samoa with Especial Reference to the Alcyonaria, by Lewis R Cary, iv Formed Components and Fertilization in the Egg of the Sea urchin *Lytechinus variegatus*, by Esther C Hendee Pp ii+105+22 plates (Washington, D C Carnegie Institution)

Proceedings of the United States National Museum Vol 78, Art. 19 Notes on the American Bats of the Genus Tadarida By H Harold Shamel (No 2862) Pp 27 (Washington D C Government Printing Office)

Carnegie Institution of Washington Publication No. 414 Contributions to Embryology, Vol 22 Nos 126 to 133 No 126 Focal Deficiencies in Fetal Tissues and their Relation to Intra uterine Amputation by George L Streeter No 127 Human Tubal Ova related Early Corpora Lutea and Uterine Tubes, by Edgar Allen, J P Pratt, Q U Newell and L J Bland No 128 Phagocytic Activity and Morphological Variations of the Ciliated Epithelial Cells of the Trachea and Bronchi in Rabbits, by Marian W Ropes No 129 Observations on the Development of the Human Female Genital Tract, by Richard H Hunter No 130 Ontogeny and Phylogeny of the Nasal Cartilages in Primates, by I Chuan Wen No 131 A Human Embryo with 14 Pairs of Somites, by Chester H Heuser No 132 Area vitellina of Chick Blastoderm in Tissue Cultures, by Z Grodzinski No 133 On a Series of Placental Stages of a Platyrrhine Monkey (*Ateles geoffroyi*) with some Remarks upon Age, Sex and Breeding Period in Platyrrhines, by George B Wislocki Pp iii+192+40 plates (Washington D C Carnegie Institution)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1930 Pp 23 (Batavia)

Annual Report of the Meteorological Observatory of the Government General of Tyōsen for the Year 1928 Pp iv+164 Annual Report of the Meteorological Observatory of the Government General of Tyosen for the Year 1929 Pp. iv+170 (Zinsen)

Journal of the Faculty of Science Imperial University of Tokyo Section I Mathematics, Astronomy, Physics, Chemistry Vol 2, Part 5 Pp 133-154 0.40 yen Section 2 Geology, Mineralogy, Geography, Seismology Vol. 3, Part 3 Pp. 131 183 1 20 yen Section 4 Zoology Vol 2, Part 3 Pp 141 224 1 30 yen (Tokyo Maruzen Co Ltd)

República Argentina Ministerio de Agricultura de la Nacion Anales de la Dirección de Meteorologia, Tomo 19 Conteniendo las observaciones practicadas en el año 1928. Vol 1 Resultados de las Observaciones Aerológicas effectuadas con Globos pilotos en el Observatorio Regional Buenos Aires (Villa Ortuzar) Pp 21+54 graficos (Buenos Aires.)

CATALOGUES.

Rare and Interesting Works on Entomology and Arachnology (New Series, No. 25) Pp 80 (London Wheldon and Wesley, Ltd)

Voyages and Travels before 1750, with a few Early Atlases Books on Navigation, Mathematics and Kindred Subjects. (Catalogue 538) Pp. 66 (London Francis Edwards Ltd)

A Catalogue of Books on Philosophy (No 1458) Pp. 28 (Cambridge Bowes and Bowes.)

Diary of Societies.

FRIDAY, JUNE 19

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 3 and at 5.15 —Discussion on Audition to be opened by Dr C S Myers —Dr E D Adrian The Microphonic Action of the Cochlea i[n] Relation to Theories of Hearing —Dr R T Beatty Auditor[y] Mechanisms —Dr A. W G Ewing High frequency Deafness.—Dr F Allen The Perception of Intensity of Sound in Normal, Depressed and Enhanced States of Aural Sensitivity —Dr E G Richardson Th[e] Dynamical Theory of the Ear —Sir Richard A S Paget, Bart. Audition in Relation to Speech, and the Production of Speech Sound[s] by the Human Vocal Apparatus, by Acoustic or Electrical Resonators and by Musical Instruments —Dr E W Scripture The Nature o[f] the Vowels —Dr E. Meyer The Analysis of Noises and Musica[l] Sounds —Dr C V Drysdale Acoustic Measuring Instruments — Dr H Banister The Basis of Sound localisation —Dr A. H Davis The Measurement of Noise.—Dr F Trendelenburg Objective Measure[-]ment and Subjective Perception of Sound —Dr G Waetzmann an[d] H Heisig The Measurement by Resonance Telephone of the Threshol[d] Sensitivity of the Ear —Major W S. Tucker The Localisation o[f] Sound Derived from Observations of Intensity —Prof E M vo[n] Hornbostel The Time Theory of Sound localisation A Re statement

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section), at 5 —Specia[l] General Meeting

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8 —Prof F J Browne The Zondek Ascheim Reaction in Chorion Epithelioma.—Dame Louise McIlroy and Dr Gladys Hill Pregnanc[y] Complicated with Diabetes

ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8 30 —Specia[l] General Meeting

SATURDAY JUNE 20

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEER[S] (at Newcastle upon Tyne), at 2 30 —A Walker Interim Report [o]f the Support of Workings in Mines Committee

ROYAL SOCIETY OF MEDICINE (Orthopædics Section) (at Oxford)

MONDAY, JUNE 22

ROYAL GEOGRAPHICAL SOCIETY (Annual General Meeting), at 3 —Si[r] William Goodenough Presentation of Royal Medals and other Award[s] of the Society delivery of Presidential Address, Annual Report [o]f the Council

TUESDAY, JUNE 23

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W 1), at 7 30 Gossip Meeting

WEDNESDAY, JUNE 24

ROYAL SOCIETY OF ARTS, at 4 —Annual General Meeting

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 11 Chand[os] Street, W 1), at 8 30 —Dr A R Redfern, Dr Sybille Yates, and D[r] J C Young Symposium on Phobias Discussion to be opened b[y] Dr E Miller

THURSDAY, JUNE 25

ROYAL SOCIETY, at 4 30 —Prof S Chapman Some Phenomena of th[e] Upper Atmosphere (Bakerian Lecture).

ROYAL SOCIETY OF MEDICINE (Urology Section) at 5 30 —The Treatmen[t] of Inoperable Carcinoma of the Bladder

FRIDAY, JUNE 26

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Oxford).

SATURDAY, JUNE 27

BRITISH PSYCHOLOGICAL SOCIETY (at Reading University), at 3 15 Papers on Oscillation —Miss M I Dunsdon Reversible Perspectiv[e] and the Effect of Conation —Mrs H W Oldham Oscillation i[n] Sounds of Low Intensity —Demonstrations of Apparatus by D I Vincent (*a*) A Mirror Tachistoscope Without Moving Parts, (*b*) A Apparatus for Producing Sounds of Predetermined Wave form.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Oxford).

PUBLIC LECTURES.

TUESDAY, JUNE 23

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary s Hospital, W 2), [at] 5 —Prof H Hartridge The Theory of Hearing

FRIDAY, JUNE 26

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Healt[h] Division), at 5 —Sir Thomas Legge Industrial Poisonings

BI-CENTENARY.

JUNE 23 TO 29

ROYAL DUBLIN SOCIETY (Bi Centenary Celebrations) (at Ball s Bridg[e] Dublin).

Tuesday June 23, at 8.30 —Conversazione

Wednesday, June 24, at 11 A.M —Scientific Proceedings.

Thursday, June 25, at 11 A M

At 3 —Anniversary Stated Meeting

Friday, June 26, at 11 A.M

Saturday, June 27, at 2.

Monday, June 29, at 8 30

SUMMER MEETING.

JUNE 22 TO 24.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Harrogate).

SATURDAY, JUNE 27, 1931.

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Professionalism and Science.

ONE of the main features of the development of science during the nineteenth century, as Prof A N Whitehead has pointed out in " Science and the Modern World ", is the twin growth of technology and professionalism Science was then for the first time conceived as a vast mine of ideas for utilisation in practical life, and in the disciplined attack on problems thus encountered in technological developments the scientific worker rapidly passed from amateur to professional status

The professionalism of science is one aspect of the problem of specialisation which confronts the educationist to-day It can scarcely be disputed that the complexity of modern science and of industrial technology demand intensive specialisation and tend to encourage the growth of various scientific professions At the same time, the growth of professional organisations among scientific workers and the marked movement towards registration in post-War Europe, while likely to assist in the participation of scientific workers in public affairs, are not without their own special dangers

The specialised knowledge and restricted outlook of scientific workers themselves must be recognised as among the factors which have hindered the establishment of right relations between science and leadership Few scientific specialists could be named whose knowledge and opinions would be accepted as having much weight outside the narrow field in which they have elected to pursue their special studies or researches In many cases their training has not even equipped them with the powers of expressing the results of their work in forms which facilitate its appreciation and assimilation in the normal life of the community

It must be admitted that chemists, physicists, and other scientific workers are frequently characterised by a celibacy of intellect which curiously resembles the physical celibacy practised by the learned in the Middle Ages This celibacy of intellect on the part of individual scientific workers is one of the main causes of the ineffectiveness of their professional organisations, which are rarely able to secure sufficient support from the general body of members for the success of policies originated by a few more fertile minds If the future of society largely depends on our ability to link administrative power with knowledge of the scientific factors involved in our modern problems, that combination can only be secured when the scientific worker adds to his knowledge the wisdom which is the fruit of a balanced development

The problem is fundamentally educational Our present educational system on one hand produces administrators, frequently of a high order of ability, but whose complete ignorance of science renders them incapable of assessing the scientific factors upon which all our modern problems turn On the other hand, its tendency to excessive and premature specialisation produces a diversity of specialists often devoid of the political or social wisdom essential for the evaluation of the other factors involved

The problem of education must be faced by professional organisations of scientific workers if they are to assume their responsibilities of leadership The movement towards professional registration accentuates the importance of educational aspects of professional training It is essential that a sufficiently high standard of general education should be demanded of all entrants to such professions, that premature specialisation should be discouraged, and that qualification for entry to a profession of science should depend more upon the ability to apply and use knowledge than on the possession of an acquaintanceship with a mass of undigested scientific facts A danger of undue uniformity may arise, however, if the conditions of entry are too narrowly prescribed in closing a profession by a measure of registration In his recent book, "Education at the Cross-roads", Lord Eustace Percy has indicated the valuable contribution which the technical schools might make in a considered scheme of professional training

The technical school provides an important and valuable alternative method of recruiting the scientific and technical staff required by industry which may exercise a vitalising influence on professional policy and opinion out of all proportions to the numbers so recruited It also makes an important contribution to the solution of a problem which is encountered in every project for the registration of chemists or other scientific workers The efficient employment of research workers in industry is largely dependent on the existence of an equally or more numerous class of laboratory assistants capable of carrying out the routine testing or analysis and mechanical work Many such assistants acquire a high degree of experimental technique, although few have the capacity or training to originate experimental work

The career of laboratory assistant offers, however, very limited prospects Comparatively few laboratory assistants are able to qualify and enter a scientific profession by one of the recognised channels, nor is industry able to absorb such workers on its technical staff in adequate numbers Although the normal recruitment of the various scientific professions should not be from the ranks of such assistants, it would be unwise and unfair in any measure of registration to close the door entirely With proper support and co-operation, the training such assistants can obtain in the technical schools would enable them to attain the necessary standard of technique, and their more varied outlook and training might help to counteract the deadening uniformity which over-rigid conditions of entry tend to stamp upon a profession

Excessive uniformity is a real danger to professional life to-day It is fostered by the training which most scientific workers receive, and also by the conditions of industrial research with its emphasis on team work Nor is the policy of vocational selection without its tendencies in the same direction Fortunately perhaps, vocational guidance at present appears to exert only a broad influence on those proceeding to the universities, for example, as between arts and science It would be a serious danger if such methods were applied to guide into relatively narrow fields all intellects of a certain characteristic type and those alone

Scientific progress depends on more than mere advances in technique In the perfecting of technique and the evolution of corporate research or team work the professionalism of science has itself largely been developed Professionalism will, however, defeat its own ends if it succeeds to any great degree in cramping individualism and forcing on scientific workers a mediocre uniformity Progress depends on the spirit of adventure, and the spirit of science is one of questing and searching in the unknown, with its attendant risks of success and failure

The more economic necessity forces on scientific workers the development of their professional organisations, the more jealously they must cherish high ideals of craftsmanship and of service, and guard against the sterilising influence of excessive specialisation and uniformity Moreover, the very security which strong professional organisations ultimately confer on their members may itself be a snare to scientific workers

Security is but a means to an end, and a first effect of professional organisation should be to improve the conditions of employment of scientific workers, so that they can carry on their investigations without undue financial anxieties Such security makes for better workmanship by increasing the freedom of the investigator When, however, it becomes an opiate and the absence

of competition prevents the sharpening of mind on mind, security has outlived its purpose All powerful professional organisations tend to suffer from a species of inbreeding of intellect, or mental sterilisation, and it is not in an atmosphere of security and uniformity that great discoveries are made or creative ideas conceived

Specialisation is a necessary evil under modern conditions Professionalism is essential to maintain and advance high standards of technique and the due status of scientific workers Vocational guidance must play its part in reducing the wastage of human material in unsuitable occupations If in such ways the freedom, resources, and efficiency of the scientific worker are increased, it is incumbent upon him to see that there is no dimming of the spirit of adventure, the devotion to truth, the sincerity of purpose which are behind every great discovery of the past and still supply the driving force in the advance of science

Human Palæontology

New Discoveries relating to the Antiquity of Man By Sir Arthur Keith Pp 512 (London Williams and Norgate, Ltd , 1931) 21*s* net

THE last ten years have witnessed a profound change in the aspect of human palæontology Important fossils of hitherto unknown types of men and an ape (the Taungs Skull) have been found which reveal new and provocative information and add enormously to the range of facts that call for interpretation Such unexpected types of the human family as Rhodesian Man and ' the Lady of Lloyds' ' set new and intriguing problems The recent discoveries of representatives of *Homo neanderthalensis* in Gibraltar, Italy, Germany, the Crimea, and Palestine have extended the geographical range of this uncouth species and also given welcome corroboration to the generally accepted ideas as to the significance of Neanderthal Man and the part he played in human history More significant than all these discoveries are the important fossils found in China and the revelation of a new genus of the human family that is more primitive and generalised than any other type at present known The exceptional value of Peking Man, however, lies in the fact that he provides us with a bond of union between the other early members of the human family, whose fossil remains before the discoveries at Chou Kou Tien seemed to be irreconcilable with one another. At the present moment, with all this new and highly significant information collected from many scattered regions of the earth, there is an urgent need for a critical review of the whole evidence and an attempt to interpret its meaning The tempting task now for the first time becomes possible of achievement, of creating a solid and coherent foundation for a real science of human palæontology

For such a task, Sir Arthur Keith has opportunities and qualities such as no other anthropologist enjoys not merely the diligence to collect the widely scattered data and the literary skill and vivacity of style to make the new information intelligible to the man in the street, but also the freedom from the time-destroying interruptions from which those who hold university positions cannot escape

If Sir Arthur has not seized this chance in the way that would appeal to the serious student, he has rendered a useful service For the layman who wants to know what fossils have been discovered and what their meaning is, Sir Arthur has provided a useful and entertaining guide He begins with a full and well-balanced report on the Taungs Ape, for the rescue and interpretation of which he pays just and generous tribute to Prof Raymond Dart Most palæontologists will agree with his verdict *Australopithecus* is an ape closely akin to the African anthropoids, the chimpanzee and gorilla, and perhaps even nearer to the extinct *Dryopithecus*, which reveals quite definite, if slight, signs in its brain, face, and teeth of a nearer approximation to the human type than any other ape Obviously, however, the Taungs Skull itself is a relic of the survival into Pliocene or Pleistocene times of a type which must have come into being as early as the Miocene Hence this individual specimen cannot be regarded as a human ancestor, nor can its discovery in South Africa be regarded as shedding any decisive light upon the place of birth of mankind, since this ape's ancestors may have been, and no doubt were, wandering far and wide during the millions of years of Miocene and Pliocene time

Sir Arthur Keith adopts the views of Prof Davidson Black as to the significance of Peking Man, and he gives a clear and instructive report upon the excavations in China and the nature of the evidence provided by the fossils, the importance of which, he admits, it would be difficult to exaggerate There are, however, some significant omissions in Sir Arthur's commentary in particular, his neglect to use the illumination its evidence sheds on the Piltdown Skull, to which I shall refer later

The third major discovery discussed at length is

the Lloyds' Skull, found in the City of London in 1925 during the excavation of the site for the new building of the Corporation of Lloyds', and rescued for scientific investigation by Mr Warren R Dawson Sir Arthur rightly regards this tantalising fragment of highly fossilised skull as a relic of exceptional importance, which deserves exhaustive study and full discussion (As the custodian of this specimen, I can assure him that during the last two years I have been collecting the material for a monograph on the fossil, for which Miss Dorothy Garrod, Mr Warren Dawson, and Dr Matthew Young have written (1928) their valuable contributions) Later on, I shall refer to Sir Arthur's strange suggestion that this earliest Londoner belongs not to an unknown type of modern man, but to the Piltdown type !

An excellent summary is given of the new discoveries of men of the Neanderthal species and of men of more modern type in South and East Africa, Australia, America, and elsewhere, and some not altogether relevant disquisitions on the archæological work of Mr Woolley in Sumer and the problems relating to the origin of early civilisation

Taken as a whole, the survey is useful and illuminating, brightly written, and illustrated with 187 diagrams, most of them excellent, with enough of unexpected and even sensational speculation to titillate the palate of the reader, which might otherwise have become jaded by the richness of anatomical detail While realising the justice of the appreciations of this book which have appeared in the lay press, it is essential that I should direct attention to aspects of Sir Arthur Keith's treatise which must make the teacher of university students hesitate to recommend it to his class The major disappointment I experienced in reading the book was that Sir Arthur did not seize the unique opportunity that presents itself at the present moment of building all the wonderful material now available into a coherent foundation of anthropological doctrine, drastically eliminating the errors of the past and the questionable speculations of the present Instead of doing this, he has introduced a new crop of daringly improbable speculations and retained many old fallacies concerning matters of obvious fact

So much confusion has already crept into the references to the Lloyds' Skull in the public press, that it seems desirable to explain the real situation with reference to the issue which more than any other focuses the argument of Sir Arthur Keith's book

Writing in NATURE of Nov 7, 1925 (p 678), I discussed the puzzling characters of the fragment of the very ancient skull found in London, which was particularly tantalising in that the most significant parts, front, base, face, and teeth, were missing. I pointed out in what respects it differed from both *Homo sapiens* and *Homo neanderthalensis*, but eventually reached the tentative conclusion (since confirmed by Dr Matthew Young's statistical analysis), which I expressed more definitely in the *British Medical Journal* (p 854) of the same date, that 'The Lady of Lloyds' ' was " an exceptionally primitive member of the species *sapiens* "

In the course of the discussion in NATURE, however, I mentioned that while the endocranial cast presented a general resemblance to some of the smaller Neanderthal casts (Gibraltar and La Quina), it differed from them in respect of other features, in which it " closely conforms to the type found in *Homo sapiens*, as well as, curiously enough, in the Piltdown cast (*Eoanthropus*) " Sir Arthur Keith seems to have transformed this simple statement into the assumption that the London skull was a link between *Eoanthropus* and *Homo sapiens* ! Thus, he says, it does not belong " to an unknown type of modern humanity, but to a recognised type of ancient man, viz , man of the Piltdown type " (p 32) It is scarcely necessary to say that there is no warrant for this view Yet if the opinion of Miss Dorothy Garrod is correct—and of that there seems now to be no doubt—that the fossil is at least as old as the beginning of the Mousterian (and not, as my geological advisers claimed in 1925, more recent than the Mousterian), the London skull is vastly older than any known example of the species *sapiens* Hence it may belong to a hitherto unknown species

In spite of this possibility, which is even a probability, the lack of the most distinctive parts of the skull suggests that for the present it is wiser to refrain from creating a new species, and regard 'The Lady of Lloyds' ' as a very early and primitive representative of *Homo sapiens* Even if we push back her age to the Early Mousterian (? or to the Acheulean) Age, that would afford no justification for assuming that she was a descendant of (or in any way closely related to) the Piltdown Man, who belongs to a different genus fundamentally distinct in every character Elsewhere in his book (p 290) Sir Arthur Keith estimates that 200,000 years (many geologists and physicists would multiply this figure by four) intervene between the age of Piltdown Man and the Mousterian phase of culture Hence it would impose an unduly heavy strain upon the imagination to bring the Piltdown

Man and the 'London Lady' into the same genus, even if they presented any real likeness to one another As they do not, we may confidently dismiss this sensational claim as an unwarranted speculation

Sir Arthur Keith's claim for a certain resemblance of the Lloyds' Skull to the Piltdown Skull is given a spurious plausibility because he still retains his erroneous reconstruction of the Piltdown Skull Anyone who looks at the Piltdown fossils (or even Mr Frank Barlow's excellent casts of the separate fragments) can see on the posterior border of the parietal the medial part of the lambdoid suture Sir Arthur ignores this patent fact and adds about a centimetre to the posterior border of the bone (see his Figs 95, 154, 155, and 157) to make a hypothetical suture, when the real one is already present on the fossil To this error, another is added by ignoring the median plane of the skull The middle line in Sir Arthur's reconstruction is more than half a centimetre to the right of its true place, and the consequent error in the breadth of the skull double that figure, more than a centimetre Not only so, but these mistakes compel him to dislocate the natural articulation between the parietal and temporal bones and so create an unnatural and monstrous reconstruction These are not questions of opinion, but of easily checked anatomical facts, to which in 1927 I directed particular attention, with illustrative figures, in my "Evolution of Man" (pp 70-81, Figs 17 24) As Sir Arthur tells us he is "throwing sparks into the smouldering fire of the Piltdown Controversy" (p 32), would it not be wise to abandon claims, the error of which any casual visitor to a museum can detect for himself? I have referred to this matter, however, not because of Sir Arthur's provocative challenge, nor because it disposes of his suggestion to include the Lloyds' Skull within the genus *Eoanthropus*, but also to direct attention to a matter which more than any other is causing confusion in human palæontology

The widespread suspicion of the authenticity of the Piltdown Man as a valid genus is notorious, and the chief reason for the lack of agreement in human palæontology Even to-day many Continental anthropologists refuse even to refer to it in treatises on fossil man or, when they do so, brush it aside as being so doubtful that it is best to ignore it I have been to some trouble to discover the reasons for the persistence of this attitude It is not simply because the Piltdown jaw is apelike in general form, so much as the claim that the braincase associated with it conforms to the type of *Homo sapiens* Hence it is particularly unfortunate that in this book Sir Arthur Keith not only persists in exaggerating the size of the braincase and brain, but also states that "the cranial features of Piltdown Man are essentially of the modern type" (p 32), and "if we had found only the cranial parts of the Piltdown Man we should never have hesitated in regarding him as the direct ancestral type of modern man, the simian features of his lower jaw and of his teeth led us to exclude him from this position" (p 546) There is no justification for such misleading statements In my "Evolution of Man" (1927) I showed that the Piltdown skull and jaw are not disharmonious, that the general architecture of the braincase is no less simian in character than the jaw In a series of comparative diagrams (Fig 24) I adduced the evidence in substantiation of this opinion

It is strange that Sir Arthur totally ignores the clear light the evidence of the Peking Skull throws on this aspect of the Piltdown problem For the peculiar characters of the natural skull of *Sinanthropus*, which is not the result of a reconstruction, reproduce in an even more exaggerated form (especially in the view of the braincase from behind) the peculiar features of the true Piltdown reconstruction to which Sir Arthur has been objecting for seventeen years (see Nature, Oct 16 and Nov 6 and 20, 1913)

In the days when most anthropologists refrained from estimating the antiquity of man in numbers of years, Sir Arthur Keith used to juggle with big figures in his speculations More recently, when using the exact methods of physics, the reasonable probability of a figure approaching a million years has been shown to be the sort of date to assign to the beginning of the Pleistocene period, Sir Arthur has cut down his figure to 200,000 years Many years ago Profs Joly and Boltwood (1908), among others, suggested the value of radioactive changes in rocks as a geological chronometer Holmes and Lawson (1927), Kovarik (1930), and von Hevesy (1930) measured the natural disintegration of uranium into lead in the oldest igneous rocks containing radioactive elements and arrived at an estimate of 1,825,000,000 years for the earliest actual sample, or in round numbers about 2,000,000,000 as the possible age Using the time scale which geologists have gradually determined since William Smith in 1796 made the first estimate, there is little room for doubt that the end of the Pliocene can be referred to a time which is one two-thousandth of the whole scale—in other words, roughly a million years ago

Recent researches on this problem have been clearly summarised by Dr Chester A Reeds in an article entitled "How Old is the Earth?" in *Natural History* (March–April 1931) Assuming the reality of Pliocene Man, Dr Reeds suggests that the antiquity of man must be at least 1,500,000 years Against these results inferred from exact investigation Sir Arthur Keith attempts to justify his estimate of 200,000 (later in the book he makes it 250,000) for the Pleistocene period by the statement "My reason for reducing the time allowance was based on the results arrived at by students of early man's stone tools, his industries or cultures" (p 34) But this is sheer guesswork For who can decide whether Acheulean implements, which are admitted by him to have undergone no change in forty thousand years, might not also have remained under the thraldom of tradition for another forty thousand years?

If Sir Arthur whittles down the time allowance for man's early history, he runs riot in his estimates of the duration of the later phases of culture Ignoring the general trend of archæological research during the last two decades, he allows eight thousand years for the Neolithic period He does not explain what precisely he means by the discredited term 'Neolithic', or whether it refers to Britain or the Continent If the former, eighty would be much nearer the mark than eight thousand —the time it took for the use of bronze to spread from the Continent to England after the people of the former introduced the Neolithic culture in the process of getting tin from Cornwall for bronze-making

Although Sir Arthur Keith devotes only a page and a diagram to chronology, I have directed particular attention to the important questions at issue because they seem to be of crucial significance in a work bearing the title "Antiquity of Man" It is surprising, therefore, that Sir Arthur while continuing to use this title has ignored the significant work the physicists have been doing to solve the essential problem implicit in his label

It comes as a relief to find that Sir Arthur has at last abandoned his claims for a high antiquity for the Galley Hill Skull, an opinion that has always played an obtrusive part in shaping his attitude in the reconstruction of human history The vacant niche in his pantheon of our remote ancestry he now assigns to 'the Lady of Lloyds'', the oldest known inhabitant of London The fact that her skull is truly fossilised and was found in a geological deposit of remote antiquity gives her a very much stronger claim than Galley Hill Man to this honourable place Yet in abandoning the Galley Hill claims Sir Arthur also seems, at the moment when for the first time there is reasonable evidence in support of it, to have given up one of his favourite slogans—the remoteness of the antiquity of the modern type of man, even repudiating the views of his disciple Mr Leakey, whom for three years he has encouraged in his theories for assigning extreme antiquity to the human remains and associated cultures in East Africa Instead of emphasising the fact that although the Lloyds' Skull cannot be brought into strict conformity with either *Homo sapiens* or *Homo neanderthalensis*, it is probably a very ancient and primitive forerunner of *Homo sapiens*, he wants to associate it with the Piltdown Skull and to overcome the burden of incredibility by claiming that *Eoanthropus* is modern in type

In his writings Sir Arthur Keith has never shown much respect for the commonly accepted principles of biology, in particular those involved in questions of phylogeny In the present work he provides us with new examples He suggests that the Australian race (*Homo sapiens*) may have been derived from the genus *Pithecanthropus* (p 312) and the original owner of the Lloyds' Skull from the genus *Eoanthropus* yet he seems to regard both the Australian and 'the Lady of Lloyds'' as members of the genus *Homo*! Unfortunately, the diagram that forms the frontispiece does not enlighten us as to the means whereby this miracle was achieved

It is puzzling to know why Sir Arthur added the last two chapters They add nothing to our knowledge or the general argument of the book, but suggest rather that he is not serious His statement that he is going to make endocranial casts "intelligible to those who have not served an apprenticeship to anatomy", is scarcely justified by his conclusion, which is expressed in the words "I suspect that a large brain was given to man, not that he might understand life, or circumvent difficulties, but simply to enjoy it" Even more surprising is the last chapter In it he seriously discusses the possibility of an isolated example of a species of man other than *Homo sapiens*—the chapter is entitled "The Discovery of *Homo Gardarensis*—surviving in Greenland in the twelfth century A D" In the end he admits that the man was suffering from acromegaly—and uses the opportunity once more to suggest that extinct types of the human family were subject to pituitary disturbances, but without being pathological or, in fact, suffering from the usual disabilities of such lesions

I have directed attention to the weak spots in the book to make it plain why teachers who urgently need a sober presentation of the facts of human palæontology must hesitate to recommend it to their students Nevertheless, it is full of valuable information and, except in the lapses that I have enumerated, serious argument It need scarcely be said that the book is vastly entertaining

G ELLIOT SMITH

The New Popular Science

(1) *Everyday Marvels of Science a Popular Account of the Scientific Inventions in Daily Use* By V H L Searle Pp 208 (London Ernest Benn, Ltd , 1930) 10s 6d net

(2) *This Scientific Age Essays in Modern Thought and Achievement* Edited by Dugald C Jackson, Jr , and Prof W Paul Jones Pp vii + 353 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1930) 10s net

(3) *Master Minds of Modern Science* By T C Bridges and H Hessell Tiltman Pp 278 + 32 plates (London, Bombay and Sydney George G Harrap and Co , Ltd , 1930) 7s 6d net

(1) IT may be that, strictly speaking, there is no such thing as popular science, new or otherwise that science can never, in the strict sense of the term, become popular, and that it is more proper to speak of the popular approach to science There are, however, many new methods of approach to-day, pleasant paths and by ways that can be travelled without tears, and these three books bear eloquent witness of this They also strongly refute the idea that this type of book is apt to disparage the dignity of science or be unworthy the notice of true research workers For it must be emphasised, in the first place, that any real or imaginary gap between men of science and the people is becoming constantly narrower in several different ways, some of which will be here briefly noted , in the second place, the writing of so-called popular books on science is often very much more difficult and requires qualities of a different and sometimes higher intellectual calibre than does the writing of a professional text-book , and in the third place, they are often of great help to the scientific worker himself

The greatest minds have never, throughout the world's history, disdained the task of trying to reach the popular ear and heart, and the same is more than ever true to-day Also, it was never more urgently necessary than now It is a great and indispensable task

The distance between the man of science and his fellow-men is rapidly decreasing, and is being replaced by a close relationship more complex, more profound, more significant every day Science to-day enters more intimately into the daily life of the individual and its achievements meet him at every turn As Dr Murray very finely says in his foreword "The phenomenal advances of science and of its industrial utilisation, its establishment in schools and colleges, and its domestication, so to speak, by wireless sets and the like, have bred in these days a scientific consciousness of a novel and formidable kind" Who can doubt the wondrous growth of this scientific consciousness among the people, and the urgent need for its stimulation and guidance in the right spirit and in the right direction, could we but discern precisely what is right ? We may fairly safely claim, then, that the people have risen to a somewhat higher plane in intelligent appreciation of things scientific, and that, again quoting Dr Murray, the "mild thrills and genteel dilettantism of the Victorian lecture room have given place to a stronger spirit"

Then again, the gap is narrowed by a change of attitude in the man of science himself Has he not become more human, possibly even more humble ? He may even yet come to realise that he himself, like the rest of mankind, is a wholly insignificant nonentity in a universe growing ever more wonderful, mysterious, and grander as he advances in knowledge, and will be assiduous in passing on this fact to his fellows, as indeed some are already doing It is far more rational to exert himself to the utmost to invoke the people's interest, help, and sympathies, and, like Mr Searle, enjoy nothing better than a talk with the man in the street True, Mr Searle's excellent book is really intended for the intelligent boy, but in matters of science we are all boys—or girls—and this book may be read and enjoyed by intelligent youngsters up to ninety or more, whether professed men of science or not

(2) It is a rather surprising fact, though it needs but little reflection to establish it, that much of that which now comes within the category of popular science—the new popular science—is of considerable value to the man of science himself It will be obvious indeed, in these days of extreme specialism, how very helpful such books can be to the man who, closely and narrowly specialising in one small corner, wishes to know something of the whole world of science in general, and of literature too Mr Searle's book, as we have already noted is intended primarily for the intelligent youth—that

is, in many cases, for the scientific worker in embryo—and though of the 'popular' kind, it will prove extremely stimulating to the student of any branch of science, but this, our second book under review, is of an entirely different sort, and takes a wider range The editors may perhaps feel that it does not strictly belong to what is commonly understood as 'popular' scientific literature, yet, from what has already been said above, they will assuredly not have any ground for mortification or scent any sort of stigma or degradation

The work, a collection of essays by eminent thinkers on both sides of the Atlantic, including H G Wells, Dean Inge, Sir Richard Gregory, Ray Stannard Baker, Edwin E Slosson, will provide an intellectual treat for any man, whether scientific worker or layman, and for the specialist it will be a welcome and refreshing diversion The editors are justified in their hope that the book will meet the needs not only of technical students for whom it is directly intended, but also will appeal to a far wider circle Sir Richard Gregory writes on "Practical Purpose"—science justified by its works, a favourite theme, with which he deals in a masterly manner, H G Wells and others write on specialisation, Ernest Dimmet on the art of reading, Dean Inge on success—one of the most cheerful disquisitions in the book, M Luckiesh on "Men, Atoms, and Stars", which makes us shrivel into nothingness, and Maurice Holland on the "Voice of Research", which makes us swell into visibility once more As a combination of great science and great literature, the book is unique, and wonderfully exhilarating

(3) With "Master Minds of Modern Science" we feel on surer ground, at least, as regards categories and classifications This is unmistakably a popular science book, rather of the older than the newer type, and describes the work of leading modern scientific workers, but, though fairly comprehensive, it is evident that someone or other is bound to find gaps It is no doubt a useful contribution to the history and biography of scientific achievement The chapter on Luther Burbank and his work, the wizard of the garden, is of particular interest, for his work is not perhaps so well known in Great Britain as it should be, especially when we reflect that we are a nation of enthusiastic amateur gardeners The book has some excellent illustrations, is well printed in large type, and for those who wish to gain a general idea of some of the recent achievements of science it can be thoroughly recommended W G L C

Our Bookshelf.

Up and Down in California in 1860–1864 the Journal of William H Brewer, Professor of Agriculture in the Sheffield Scientific School from 1864 to 1903 Edited by Francis P Farquhar (Published on the Foundation established in Memory of Philip Hamilton McMillan of the Class of 1894 Yale College) Pp xxx + 601 + 32 plates (New Haven, Conn Yale University Press, London Oxford University Press, 1930) 27*s* net

THE author was the well known professor of agriculture in the Sheffield Science School of Yale, and sometime president of the National Academy of Sciences In 1860, as a young man, he joined J D Whitney as principal assistant in the new Geological Survey of California, which it was hoped would advise as to the future development of the mining industry, then in dire distress A second part of the work was to report on the plants and animals, and to Brewer was assigned the former Whitney, with a love of thoroughness, made it primarily into a topographical survey, upon which the geology could be charted His action here undoubtedly trained the men and set the standard on which the whole United States was mapped Brewer led the first field party, and his letters now published show him directing and carrying out every class of work, except botany This he continued to do until 1865, the survey being continued to 1873, dying itself but giving birth to the Federal Geological Survey Department in 1879

Brewer was a voluminous letter-writer, and he numbered his letters serially, as he did his plants He zigzagged across California from south to north, and he always wrote what he saw, seldom what he heard Consequently, we have an account here of California as it was in 1860–65 It tells of the mountains and valleys, of the mines and of the plantations, of the old Latin civilisation and of the Indian missions, of the Indians themselves and of the westerners, of the animals and of the plants It is all simple, the life and work of a camping party and of the people they met There are no striking adventures, no sensational discoveries, merely an account of trails and conditions in a yet unopened country As an example may be mentioned Brewer's letter on the Yosemite Valley and its waterfall of 2600 feet, a far simpler but more compelling account than any of the numerous, often exaggerated stories of this famous canyon The letters are a record beyond price to future historians of California, but they are too local to be of general interest, too domestic to allow scope for wider deduction or speculation They serve their purpose in the history of the United States, and this is further served, for their editor has chosen to illustrate them by contemporary drawings and prints

The Balancing of Engines By Prof W E Dalby Fourth edition Pp. xii + 321 (London. Edward Arnold and Co, 1929.) 21*s* net.

THE necessity of balancing steam engines was first felt in connexion with locomotives, and so long ago as 1834 Bodmer patented a method

which was tried with some success about ten years later Many horizontal marine engines were fitted with balance weights on the cranks, but balancing became of far greater importance with the introduction of fast-running engines for driving electric generators and torpedo craft, and with the construction of very large triple-expansion engines for Atlantic liners Readers of the life of Sir Alfred Yarrow will recall his experiments on vibration made aboard the *Majestic* during a trip to America in 1890 experiments which led to his collaboration with Dr Otto Schlick in the introduction of a design of a balanced four-cylinder engine

Papers on balancing were read to the Institution of Naval Architects and the Institute of Marine Engineers by Schlick, Yarrow, Malloch, McFarlane Gray, and others, and it was to the former Institution Prof Dalby read his important papers on the balancing of marine engines of 1899, 1901, and 1902 In 1901 he dealt with the balancing of locomotives, in a paper read to the Institution of Mechanical Engineers, and the following year he published the first edition of his well-known text-book In these papers and text-book he introduced the idea of a reference plane and a schedule by means of which a draughtsman could find the balance weights for a complex system of masses about an engine crank shaft, and his methods have been used all over the world The work of balancing locomotives has recently assumed a new importance through the experiments of the Bridge Stress Committee, and in view of this, Prof Dalby in the fourth edition of his text-book has added a chapter dealing with the work of the Committee and at the same time has rewritten the chapter on locomotive balancing A new chapter written for this edition, on the balancing of internal combustion engines, will be found of great use to those concerned with the design of engines for motor cars, aeroplanes, and motor ships

Photochemistry By Dr D W G Style (Methuen's Monographs on Physical Subjects) Pp vii + 96 (London Methuen and Co , Ltd , 1930) 2*s* 6*d* net

THE introduction of a volume on photochemistry into this well-known series of monographs on physical subjects, gives us an indication of the rapid change which has occurred in the study of the chemical action of light by the introduction of the Stark-Einstein law of photochemical equivalence in the primary light process, and of the work of Franck on the interpretation of band spectra and their significance in indicating the process of molecular dissociation This small volume is well and clearly written and is by no means uncritical Attention is directed first to the primary light process, and the possible subsequent reactions which the photo-excited molecule may undergo are then discussed in some detail A little more concerning chemi-luminescence and fluorescence might well have been included in these sections The fourth chapter is devoted to a consideration of the still debatable problems connected with the dependence of the quantum yield on temperature and wave-length, and the volume concludes with a brief summary of the experimental methods adopted in photochemistry

Although a rather slender volume, the reviewer can subscribe to Prof Allmand's introductory remark that the volume can be recommended with confidence to students and research workers E K R

The Statesman's Year Book Statistical and Historical Annual of the States of the World for the Year 1931 Edited by Dr M Epstein Sixty-eighth Annual Publication, revised after Official Returns Pp xxxiv + 1462 (London Macmillan and Co , Ltd , 1931) 20*s* net

THE new issue of this valuable work of reference has again been thoroughly revised in the light of official statistical publications Many annual returns for 1930 are included, and in some respects the revision is even later Mention is made of the change of political status in Spain The year was one of census enumeration in several countries, and new figures are included for the United States, Hungary, Norway, Switzerland, and several other countries The introductory tables record world production of coal, oil, iron, steel, and some other commodities An extension of these tables is one of the few improvements that it is possible to suggest Two coloured maps show respectively the administrative divisions of Yugoslavia and the status of South American boundaries, with the areas that are still in dispute A welcome feature of this year book is the small bulk, which is retained from year to year

Modern Psychotherapy By Emanuel Miller (Modern Treatment Series) Pp 131 (London Jonathan Cape, Ltd , 1930) 5*s* net

DR MILLER is to be congratulated on a very readable and concise work He does not unduly stress only one aspect of the subject, as so many modern writers do , but provides us with a well-balanced summary of the three main schools of psychoanalytic thought The author takes a very sensible attitude towards the treatment of the psychoses by psycho-analysis Although psychoanalytic theory may explain the mechanism of a great many psychotic symptoms, it does not explain their cause and certainly does not supply a useful therapy The author wisely points out that "full understanding can only come through personal contact with cases and through sympathetic understanding of what are very real and very painful disorders" Psychological medicine is not learnt in the laboratory with the experimental psychologists , but in the infinitely more difficult school of contact with life and its problems

The Gardener's Year By Karel Čapek Pp 160 (London George Allen and Unwin, Ltd , 1931) 3*s* 6*d* net

THIS very entertaining volume with its delightfully humorous pictures should be read by all gardeners The text is as amusing as the illustrations, and though in no way scientific, much common sense underlies the humour to be found on every page

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

A Simple Method of Investigating Wireless Echoes of Short Delay

ONE of the two methods most commonly used in the determination of the equivalent height of the Kennelly Heaviside layer is that involving the measurement of the time required for a brief wireless signal to travel upwards to the reflecting region and back This quantity is most conveniently determined by causing an emitting station to send out very short pulses of radio frequency energy, and measuring, at a point a short distance away, the difference between the times of arrival of a particular signal pulse via the ground and via the upper atmosphere

Various methods of producing the short pulses required have been used,[1] but in all cases a somewhat elaborate modulating device has been necessary We

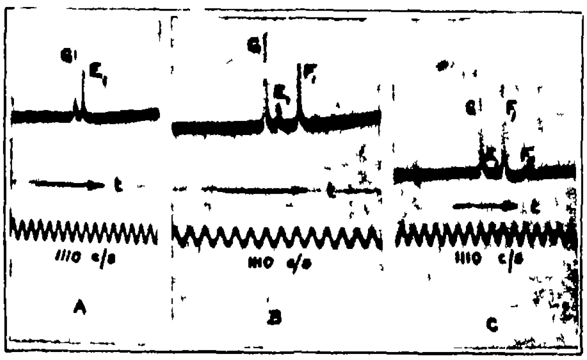


FIG 1

have found, however, that it is possible to dispense with any special modulating system for controlling the emission from the oscillator and still obtain pulses of satisfactory type If the grid leak of an ordinary triode oscillator is increased to a relatively high value, the generator itself produces suitable short pulses of radio frequency energy alternating between uniform periods of quiescence By adjusting the grid circuit constants, both the duration of the pulse and the duration of the interval between successive pulses may be controlled This peculiar property of a triode oscillator working with a high grid leak has been previously investigated in connexion with its use for providing a unidirectional time scale for cathode ray oscillography[2]

Using an emitting station at East London College, London, E 1, working on a wave length of 80 metres, and emitting pulses of about 0 0003 sec in duration, spaced 0 02 sec apart, we have been able to record photographically at King's College, London, W C 2, 3 miles away, the reception of these pulses and their echoes from the Kennelly Heaviside layer A satisfactory arrangement for studying the characteristics of such echoes is to use a dual observational system consisting of a cathode ray oscillograph and a high-speed recording oscillograph (Duddell type) The received pulses can normally be watched as a recurring image on the cathode ray oscillograph, using a linear time base of stroke frequency coinciding with the pulse frequency, but, when it is desired to obtain a permanent and more accurate record of any particular combination of echoes, the high speed oscillograph with a suitable time scale calibration can immediately be switched into use

Some specimen records, taken on June 15, between 1800 and 2000 G M T are shown in the accompanying diagrams (Fig 1) In each case the first impulse (marked G) is that received direct via the ground, the subsequent pulses being due to waves reflected by the upper atmosphere The records are of interest in confirming results previously obtained in England using the frequency change method of measuring equivalent heights, in that they indicate reflections from two regions at different heights in the upper atmosphere Record (a), taken at 1830 G M T, illustrates a singly reflected pulse E_1 from the lower of these two regions (Region E) Record (b), taken at 1850 G M T, shows a singly reflected pulse E_1 from the lower region and a singly reflected pulse F_1 from the upper region (Region F) Record (c), taken at 1910 G M T, shows that, as sunset (2020 G M T) was approached, the singly reflected pulse E_1 from the lower region was less intense, while that from the upper region F_1 was much more marked A pulse F_2 indicates double reflection from the upper region

This work is being carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research

E V APPLETON
G BUILDER

Wheatstone Laboratory,
King's College, Strand, W C 2,
June 17

[1] Breit and Tuve *Phys Rev* **28**, p 554 1926 Tuve and Dahl, *Proc Inst Rad Eng* **16**, No 6 p 794, 1918 and Goubau, *Phys Zeit*, **31**, No 7, p 333, 1930

[2] *Proc Roy Soc* A, **111** p 672 1926

The Atomic Weight of Xenon

BY the kindness of Dr F W Aston, who placed at our disposal 235 c c of highly purified xenon, we have been enabled to redetermine the atomic weight of this element

Using a highly accurate micro balance, the design of which will be published shortly, we have measured the pressures of xenon and pure oxygen at which the densities of the two gases are equal This has been done for two different densities, corresponding to pressures of xenon of about 80 and 153 mm The two ratios PO_2/PXe when all corrections were made were found from two series of very concordant readings to be 4 1035 and 4 1049 respectively at 18° C

The limiting density is obtained by extrapolating these two ratios linearly to zero pressure, and is 4 1020 At such a low pressure as 80 mm a linear extrapolation is certainly legitimate, as any curvature would be quite beyond the limit of error of our measurements Hence the atomic weight of xenon is $4\ 1020 \times 32 = 131\ 26(4)$ The error of measurement does not seem to be greater than $\pm 0\ 005$ This agrees remarkably well with Dr Aston's value, $131\ 27 \pm 0\ 04$, derived from the measurement of the intensities of the lines of the various isotopes in the mass spectrograph[1]

The gas supplied to us was originally very pure It was fractionated a number of times, until further treatment of the heaviest fraction gave no increase in density

It may be noted that after the first fractionation the difference in balancing pressure between the first and last fractions was only about one part in 900

R WHYTLAW GRAY
H S PATTERSON
W CAWOOD

The University, Leeds,
June 16

[1] *Proc Roy Soc*, **126**, p 511, 1930

The Supposed Resting Stage of *Limnocnida Indica* Annandale.

THE life history of this fresh water medusa has been a baffling problem since its discovery twenty years ago [1] The jelly fish occurs in certain rivers flowing down the eastern slopes of the Western Ghats of the Bombay Presidency during definite seasons of the year (March to May) What happens to the species during the rest of the year has been more or less a mystery From the fact that it occurs year after year in certain parts only of these rivers, it has been supposed that there is a fixed asexual hydroid stage in the life cycle of the animal, which buds off medusæ at the commencement of the hot weather [2] Although

FIG 1 ×50

the medusæ were kept under observation in the field, and a careful search for the hydroid stage made on more than one occasion, no clue to the mystery was obtained Nearly eight years after the discovery of the jelly fish, the late Dr Annandale, as a result of further observations, recorded his opinion that the species "must have a fixed or resting stage in its life history, perhaps with the structure of a minute hydroid, or more probably encysted in a form that would not be recognisable with our present knowledge" [3]

While on a recent tour to Medha (Satara Dt, Bombay), where the species was first discovered, I found certain very minute bodies in great abundance at the bottom of a deep rock pool in the course of the Yenna River, sticking to minute particles of mineral matter (Fig 1) They are of different sizes (0 15–0 34 mm in diameter) and in various stages of development, from the presumably early spherical form to the fully developed capsule like or oblong form, but the latter are much more numerous than the early or intermediate forms They have a transparent covering of apparently chitinous matter with pits and minute pores on the surface The cavity of the body is more or less filled with refringent spherical granules in a clear, sticky, viscous fluid In the early spherical form there are numerous minute elastic and sticky threads issuing through the pores on the surface which serve to anchor it to particles of mineral matter The more advanced oblong form is, however, attached by a short, stout, elastic stalk which is composed of minute threads of sticky material aggregated together with inclusions of foreign matter between them The surface of the external covering is distinctly pitted, with traces of minute pores in each pit In what appear to be the very advanced forms, the granular material forms a few large spherical masses clustered together like a bunch of grapes It appears probable, from the occurrence of a few empty bodies with their external covering ruptured, that the spherical masses on completion of development within the capsule find their way out

It will be of interest to add a chance observation which I have made on a small number of medusæ, male and female, from the Koyna River near Karad (Satara Dt, Bombay), kept in a small glass aquarium At the end of the day of capture, a gravid female discharged its eggs, many of which settled down at the bottom of the aquarium Examination of the eggs under the binocular microscope showed that they were attached to the bottom by means of minute elastic threads from the surface of the eggs They were spherical in form, had a thin, transparent apparently chitinous covering with minute pores, and were filled with a viscous fluid containing numerous refringent granules The remarkable resemblance between the discharged eggs and the early stages of the so called resting bodies suggests a clue to the life history of the jelly fish Evidence to prove that the egg passes directly into the resting stage, and that the medusæ have their origin from the resting body without the intervention of a hydroid stage, is still incomplete It seems probable, however, that the so called resting bodies lie dormant during the rainy and cold seasons, and discharge their contents at the beginning of March in the form of very minute medusæ, which do not generally rise to the surface until they have attained to a comparatively advanced stage of development, and that a fixed hydroid stage is altogether omitted from the life cycle

These resting stages or bodies are still under observation, and a detailed account will be published in due course in the *Records of the Indian Museum*

H SRINIVASA RAO

Zoological Survey of India,
Indian Museum,
Calcutta

[1] NATURE, **87**, 1911 p 144 and *Rec Ind Mus* 7 1912 p 253
[2] Gravely and Agharkar, *Rec Ind Mus*, 7, p 403, 1912
[3] *Rec Ind Mus*, **16**, pp 109 112, 1919

Potential Temperature and the Stratosphere

THE high coefficients of correlation between the measures of certain meteorological elements at the tropopause and the air pressure at 9 kilometres cited by L H G Dines in his letter in NATURE of May 30 may be welcomed as a reminder of the intricate but regular associations of the meteorological elements in the sequence of weather changes which are so vexatiously irregular at the surface

It is worth noting that, according to the data given by W H Dines, the 9 kilometre level is the level at which the relation of pressure to temperature along the horizontal is normally that of the dry adiabatic so that dry air might travel up gradient or down-gradient, along the horizontal, without exciting any resilience

I mention this because when Mr Dines's letter refers to the enormous stability in the stratosphere on account of the isothermal condition in the vertical I am prone to think of resilience, and while allowing

that if I lift air vertically I shall find vigorous resilience, I shall find no resilience in air moving along a surface of equal potential temperature whether the motion be up gradient or down gradient, up hill or down hill Along an isentropic surface up hill coincides with up gradient above 9 km, but with down gradient below that level Consequently, I have no difficulty in visualising an automatic flow of air up hill or up gradient provided the isentropic surface shows the way That is a kind of flow which is almost unthinkable at the earth's surface but possible in the free air, and may bring the high correlations within the sphere of recognised probability

I may take the opportunity to remark upon the great change of mental attitude towards the general atmospheric problem that is natural to the contemplation of the conditions of the free air Any time within the past fifty years, judging by what happens at the surface and in the laboratory, I should have had no objection to offer to the suggestion that pressure gradient means potential energy, which might be sacrificed to produce velocity of air or natural wind, and now, if I think of pressure-gradient as the deformation of an isobaric surface from the horizontal by the shifting of air mass, as it must be, I find that the energy obtainable by the levelling of a hump must be spent in filling up a hollow, and apart from difference of entropy there is nothing available to produce kinetic energy

In the upper air, pressure gradient and wind-velocity automatically increase and decrease together So pressure gradient comes to be the mere index of the response of an air current to the 'centrifugal force' of the earth's rotation, aided or counteracted by any local curvature of the air's path

In this way, centres of local circulation, whether of low pressure or of high pressure, take quite a different place in the hierarchy of atmospheric influences from that which in the past century they have been supposed to occupy The real dynamical agents of the free air are the currents which find their cartographical expression as the straight isobars running between high pressure and low pressure, riding 'side saddle' on the gradient The high and the low are mere incidents of the relative motion of air currents of different directions In the northern hemisphere wherever the passing currents keep the English rule of the road, with opposing traffic on the right, high pressure (and generally fine weather) between them is the inevitable consequence, but wherever the atmosphere adopts the continental rule of keeping the opposing traffic on the left, there a 'low' between them is equally inevitable

The concentration of attention upon centres of high or low pressure, which are practically points of no motion, instead of upon the air currents which cause them, is a curious aberration of dynamics It is to some extent like concentrating attention on the point of contact of a wheel with the rail as the important point of influence in a dynamical system of that character

There would be little to choose between the importance of the effects on either side of a travelling current if the air kept 'dry', the real trouble begins when the juxtaposition of the currents from different directions brings the temperature of air below its point of saturation—then an enormous release of energy from its store in the water vapour of the air with little sacrifice of temperature, and in consequence all the dynamical and physical features of the cyclone and the depression

These conclusions follow from the assumption of an automatic balance between wind velocity and gradient, under the influence of the earth's rotation, which is not likely to be appreciated by those who fix their attention on the behaviour of air at the surface, but which deserves consideration when the causes of the high correlations of the upper air are being sought

From this point of view the interactions of air-masses within the regions of cyclonic depressions which the Norwegian school of meteorologists has turned to such profitable use within the past twelve years are the by-play and 'asides' of the main atmospheric drama under the influence of the surface friction They are complicated by the release of the energy stored in water vapour wherever condensation is set up

NAPIER SHAW

10 Moreton Gardens, S W 5,
June 10

Calculation of the Latent Heat of Fusion of Camphor from Vapour Pressure–Temperature Data

IT was recently pointed out [1] that of the two available values, namely, 400 and 498, for the molecular depression of freezing point (K) of camphor, the larger figure seemed the more correct, because it had been subjected to an *a posteriori* verification by its discoverer Jouniaux,[2,3] and, secondly, because the smaller value had been drawn from a fusion point diagram [4] of doubtful accuracy [5]

Briefly, Jouniaux's proof consisted in deducing the latent heat of fusion of camphor (L_f) from his own value for K and comparing the result with the figure obtained by calculation from quite different physical measurements recorded in the literature by other workers This he accomplished as follows, using the equation $L_f = \frac{T_f}{E}(v_l - v_s)\frac{dP}{dT}$, where p is vapour pressure, v_l and v_s are specific volumes of liquid and of solid, E is the mechanical equivalent of heat, and T is the absolute temperature

The quantity v_l was obtained from Kuhara's measurements [6] of the density of liquid camphor at 205° From three vapour pressure temperature measurements for camphor selected from the data published by Ramsay and Young,[7] Allen,[8] and Vanstone,[9] the constants m, n, and z in the Kirchhoff Dupré Rankine [10,11,12] equation $\log_e p = \frac{m}{T} + n \log_e T + z$ were evaluated as $m = -2108\ 72$, $n = 10\ 1142$, and $z = -51\ 1692$ Putting $T = 451\ 6°$ (melting point of camphor) in this equation, the value of p at the melting point of camphor was found to be 398 7 mm, also $\frac{dp}{dT} = (nT - m)\frac{p}{T^2}$, whence, by substitution in Clapeyron's equation,

$$L_f = \frac{p(v_l - v_s)(nT_f - m)}{ET_f} = 8\ 23 \text{ cal}$$

Now taking his previously determined value for K, Jouniaux showed that van 't Hoff's expression $K = 0\ 02T^2/L_f$ yielded a value for L_f equal to 8 24 cal, and thus afforded an elegant check on the correctness of his experimental observations.

Having recently found that the molecular depression constant for camphor lies in the neighbourhood of 395 rather than 498, we have examined more closely the above "vérification *a posteriori*" (*sic*), with the following results

Jouniaux's calculation contains several arithmetical errors Using the data chosen by him in this connexion, the values for m, n, and z should be − 362 8, 14 23, and − 80 20 respectively, and not those given above L_f, therefore, on revision becomes 6 33 cal, neither corresponding with the figure $K_{\text{camphor}} = 495$ nor 400, for which L_f should have been 8 24 and 10 2 respectively

The reasons underlying these disagreements would appear to be plain The vapour pressure-temperature measurements utilised by Jouniaux are evidently inaccurate, for, although the Kirchhoff Dupré-Rankine equation is known to apply, with possible errors of about 3 per cent (Juliusburger [13]), to many organic substances, it becomes apparent by taking other sets of vapour pressure-temperature values from the records referred to by Jouniaux that widely different figures for m, n, and z result The following two examples illustrate this

$$(1)\left\{\begin{array}{l} T_1=273^\circ,\ p_1=0\ 06\ \text{mm} \\ T_2=313^\circ,\ p_2=0\ 60\ \text{mm} \\ T_3=353^\circ,\ p_3=9\ 15\ \text{mm} \end{array}\right\} \quad \begin{array}{ccc} m & n & z \\ -3026 & 64\ 85 & -355\ 62 \end{array}$$

$$(2)\left\{\begin{array}{l} T_1=351^\circ,\ p_1=6\ 4\ \text{mm} \\ T_2=404\ 1,\ p_2=75\ 37\ \text{mm} \\ T_3=430,\ p_3=181\ 5\ \text{mm} \end{array}\right\} \quad \begin{array}{ccc} m & n & z \\ -11{,}950 & -14\ 31 & 119\ 78 \end{array}$$

(1) From paper of Allen (loc cit)
(2) From paper of Vanstone (loc cit)

It is therefore obvious that these measurements are not nearly sufficiently reliable to bear the mathematical treatment that Jouniaux attempted to give them In addition, the value he used for the density of liquid camphor was determined many years ago (Kuhara [6]) and relates not to the melting point (178°) but to 205° The density for solid camphor at the melting point is quoted as 0 980 without references, Beilstein gives D_0^0 1 000 D_5^5 0 9998, D_9^9 0 992

In conclusion, it is evident that neither as a verification of his own work nor as a means of discrimination between two values of K_{camphor} so widely different as 400 and 498 are such applications of thermodynamic formulæ of much practical use

R J W LE FÈVRE
CATHERINE G TIDEMAN
The Ralph Forster Laboratories of Organic Chemistry,
University College, London

[1] R J W Le Fèvre NATURE, 126, 760 1930
[2] *Bull Soc Chim* [4] 11, 546 722 993 1912
[3] *Compt rend* 154, 1593, 1912
[4] Caille *Compt rend* 148, 1461 1909
[5] Le Fèvre and Webb, *Jour Chem Soc*, May 1931
[6] *Am Ch J* 11 244 1889
[7] *Phil Trans* 175, 45, 1884
[8] *Jour Chem Soc*, 77, 413, 1910
[9] *Jour Chem Soc*, 97, 429, 1910
[10] *Annalen der Physik*, 104 612, 1858
[11] Dupré, Théorie mécanique de la chaleur ', p 96
[12] Rankine, *Phil Mag* [4] 31, 200 1866
[13] *Annalen der Physik* 3, 318 1900

Prof Otto Wallach

As a former student of Prof Otto Wallach, I would suggest that the obituary notice in NATURE of April 18 scarcely does justice to the immense services which this distinguished investigator rendered to organic chemistry

Prior to 1880 the utmost confusion existed with regard to the nature of most of the substances contained in essential oils, considerable doubt existed as to the homogeneity of these 'compounds', and very few determinations of structure or synthesis had been carried out Wallach's pioneer work, commenced in 1884, quickly produced important results, and in a few years the original chaos gave place to an orderly and greatly simplified arrangement The distinguishing characteristics of pinene, camphene, limonene, terpinolene, terpinene, and phellandrene were clearly established, and gradually a light was thrown on the inter-relations of most terpene derivatives

Although other workers, notably Armstrong, von Baeyer, Perkin, Semmler, Tiemann, Tilden, and Wagner have made many noteworthy contributions to this branch of chemistry, its present condition must be regarded as largely due to Wallach It is interesting, however, that in the first few pages of his book, "Terpene und Campher", he refers to the valuable work of many of these chemists, including that of Armstrong

It is gratifying to remember that in 1909 Wallach was awarded the honorary doctorate of science of the University of Manchester At that time W H Perkin, junr, was himself directing a flourishing school of terpene research there, and it is probably not inaccurate to regard Wallach's doctorate as a personal compliment paid by one distinguished chemist to another Some years later an important communication on stereochemistry was published simultaneously in *Liebig's Annalen* and the *Journal of the Chemical Society* under the joint names of Perkin, Pope, and Wallach A survey of Wallach's work may, however, be left to the memorial lecture shortly to be delivered before the Chemical Society, and to the exhaustive review of the man and his work which will doubtless be published in the *Berichte* by his German colleagues

Wallach's students will recall the rather short, spare figure of the Herr Geheimrath, his thin grey hair and beard, his keen eyes and intent look as he passed down the centre of the laboratory to his private room, holding with almost painful care some specimen just obtained from one of his students They will remember his optimistic "Geht sehr gut", even when they themselves were by no means satisfied with the progress of the 'Arbeit', or—when a viscous oil persistently refused to solidify—"Immer noch nicht fest? Ruhig bis morgen stehen lassen"

The Geheimrath was always pleased when English students came to work with him, he greatly valued his honorary fellowship of the Chemical Society, and he was frankly pleased at his re-election about two years ago Throughout his tenure of the chair of chemistry in Göttingen, Wallach lived in the old house adjoining the laboratory in Hospitalstrasse with the name 'Friedrich Wohler' in letters of gold over the door He did not understand how a professor could wish to live further from his work than this There in the large room upstairs was kept his fine collection of water colours in which he greatly delighted In 1924 it was my privilege to call upon Wallach, then in the eighth year of his retirement (he retained a room in the laboratory by the courtesy of Prof Windaus, and long after his eightieth birthday he continued to work there) That was the first visit he had received from an English chemist since 1914, and he did not attempt to disguise the pleasure it gave him, and I am happy to think that several letters have passed between us in the last years of his life

Wallach was almost the last of the line of great German chemists—Hofmann, Kekule, Victor Meyer, von Baeyer, Fischer, Wislicenus, Hantzsch—who through rigorous discipline and with infinite patience and diligence built up the structure of modern organic chemistry, and his passing marks the close of a romantic chapter of chemical history

Many chemists in Great Britain who worked with one or other of these giants will remember them with gratitude and admiration They will recall what they owe to their fellow students, to the many admirable features of German university life, and to the knowledge gained and the friendships formed in the mountains and forests of the Harz or Thuringen or South Germany

"Nie kehrst du wieder gold'ne Zeit, so frei und ungebunden"

FREDERICK CHALLENGER,
The University, Leeds,
June 1

Pliny's Water-Mill

IN connexion with the letter on "Pliny's Water Mill" in NATURE of June 13, the accompanying photograph (Fig 1), taken by me at Ching chong-do, in Korea, in September 1899, may possibly be of interest It represents a water actuated 'pestle and mortar' commonly used at that time in the hill country of Korea for hulling rice

The apparatus consists of a beam, generally the rough trunk of a tree, about fourteen feet long, to one end of which is attached a wooden box capable of holding water, and to the other end a piece of tree trunk about two to three feet long, fixed at right angles to the beam This last forms the 'pestle' The rice to be treated is in a wooden or stone 'mortar' beneath it

FIG 1—Water actuated pestle for hulling rice at Ching-chong do Korea The bucket is shown in the act of spilling its water

The main beam with its appurtenances is balanced on a trestle so that it is free to move up or down like a 'see saw'

When the box has filled itself with water from the continuous supply furnished through the wooden trough shown above it in the photograph, the pestle at the other end rises above the mortar, and immediately the tipped box empties its water, causing the pestle to drop with a powerful blow on the rice in the mortar The box automatically rises to the filling position again, and the sequence is repeated indefinitely The photograph shows the box in the act of tipping and spilling its water

The straw covered hut in the left background of the photograph contains most of the beam, with the pestle and mortar Its interior was too dark to photograph

H GLENDINNING

Glenalmond,
St Albans, Herts,
June 15

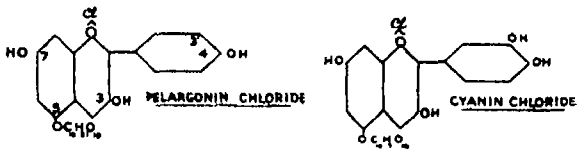
MR H P VOWLES's account in NATURE of June 13, p 889, of the Kashgar water mill is a great help towards the understanding of a hard passage, the difficulty of which is much increased by corruption of Pliny's text ?—For one false reading Mr Vowles's *undershot* water wheel suggests at once the necessary emendation, Rotis etiam quas aqua verset *obiter* et molat ; for *obiter*, hitherto unintelligible, read *subter* I suggest also that in the preceding phrase *rudo pilo* does not at all mean a *roughened* pestle, but is equivalent to *ruente pilo*, and means a *falling* pestle, or drop hammer—precisely what the sense requires We may then translate "In Italy, falling pestles, or drop hammers, are mostly used, and the grinding is moreover carried on by means of wheels, turned by a stream *flowing underneath*" *Pilum Graecum*, which occurs in a Plautine fragment, "quasi tolleno aut pilum Græcum reciproces", seems to have been the technical name for the pair of alternate hammers, working precisely as in the Kashgar mill

A more curious error lurks in the preceding clause The pestle, Pliny tells us, is armed with teeth so that unless the miller keeps a sharp look out while he is grinding (*nisi intenti pisant*), the grain will be cut or chipped (*concidantur grana*), and the iron-work smashed to bits (*ferrumque frangatur*)! It would surely need rough handling to do so Now the grain in question was *far*, or spelt, and we know that our miller was not grinding it to flour or meal, but merely cleaning or husking it for groats, and he had to work carefully and use a light hand lest the grain be chipped or broken, and—*ne farreum frangatur*—lest his *groats* be spoiled

D W T

The Chemical Effect of a Mendelian Factor for Flower Colour

IN 1914, Willstätter isolated the anthocyanin pelargonin from the flowers of the scarlet *Pelargonium zonale*, and stated that a certain violet-red variety contained cyanin, with a trace of pelargonin Recently, Robinson and his collaborators have shown that in both these diglucosidal pigments the sugar residue is probably attached at position 5 on the anthocyanidin molecule If this is so, the only structural difference between these two pigments is the extra hydroxyl group possessed by cyanin at position 3′



These anthocyanins can easily be distinguished by means of the distinct colour reactions given by their crude dilute hydrochloric acid extracts on addition of excess sodium carbonate solution Scarlet red solutions of pelargonin should give an intense violet-red, whilst the cherry red ones of cyanin turn a pure blue Extracts containing both pigments give intermediate colours With the pale coloured flowers, owing to a higher proportion of flavone pigment in the crude extracts, a green colour may be obtained which masks the true reaction and necessitates a preliminary purification The presence of even small amounts of pelargonin can also be detected by the characteristic fluorescence given by this pigment when in acid alcoholic solution

The genetical basis of the formation of these two pigments is being investigated The rose pink variety 'Constance', on selfing by Miss Cranfield, of the John Innes Horticultural Institution, gave seventeen plants resembling the parent and three salmon-pinks, the latter colour being clearly recessive

On testing, the rose-pink flowers were found to contain cyanin, a slight trace of pelargonin, and an appreciable amount of flavone, while the salmon-pinks contained only pelargonin with a trace of flavone

The effect of the factor which converts salmon into rose is, therefore, to substitute cyanin almost

completely for pelargonin, the difference being that of a single oxygen atom

In certain cases in animals a dominant colour factor has been shown to cause the production of a definite oxidising enzyme, and in this case it is not inconceivable that the factor with which we are dealing is in some way concerned in the oxidative processes of the plant

The close connexion between these two anthocyanins in the *Pelargonium* species is further demonstrated by cases of sporting from one pigment to the other

It is interesting to note that these pigments are also found side by side in certain varieties of *Dahlia variabilis*, and that the purple red aster contains both callistephin and asterin, the 3-monoglucosides of pelargonidin and cyanidin respectively

No Mendelian factor has yet come to light which effects a change in the identity of the anthocyanin pigment by means of an alteration in the nature or position of the glucosidal residue, instead of in the superficial structure of the aglucone, and it is the purpose of this note to invite further evidence as to whether this latter alternative may be the general rule

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Diamagnetism of Liquid Mixtures

TREW and Spencer [1] have recently reported some very surprising results regarding the magnetic susceptibilities of organic liquid mixtures They find large deviations from the additive law for many pairs of liquids, and in some cases, for example, mixtures of acetone and chloroform, they even claim to find the mixtures to be paramagnetic over a certain range of composition

During the past year I have been engaged in the investigation of magnetic susceptibilities of liquid mixtures, and have developed for the purpose a modification of the Quincke method of capillary ascension which has proved very convenient and accurate in practice Using dark ground illumination, the alterations produced by a strong magnetic field in the level of the liquids contained in two tubes placed side by side between the poles of an electro magnet are photographed under high magnification on the same plate One of the tubes contains benzene, which serves as a standard of comparison, and the other contains the liquid mixture under investigation The plates when measured give results which are reproducible to within one part in a thousand

The results obtained by me do not confirm the work of Trew and Spencer For example, with mixtures of benzene and carbon tetrachloride, for which they report large deviations from the additive relation, I find that the graph connecting susceptibility with composition is a perfect straight line. In the case of mixtures of acetone and chloroform, I find that there is a definite departure from the additive law, which is most pronounced at the concentration at which the density of the mixture shows the largest abnormality But the deviation is very small, being nowhere greater than three per cent of the observed value, and is incomparably smaller than that reported by Trew and Spencer.

From a theoretical point of view, there is reason to expect that molecular association in liquids may influence diamagnetic behaviour to a slight extent, but the results of Trew and Spencer seem wholly outside the range of theoretical possibility It will be noticed that the susceptibilities as measured by them for the pure liquids show large deviations from the accepted values

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May 16

[1] *Proc Roy Soc*, **131**, 209, 1931

A Simplified Lecture Demonstration of the Thomson Effect

ELEMENTARY theory represents the Thomson effect as an absorption of heat by a current traversing a temperature gradient in one direction, and an evolution of heat in the other direction In other words, when a current passes over a temperature peak, the originally symmetrical temperature distribution becomes asymmetrical, one side becoming steeper than the other

The converse effect, the production of a potential difference by an asymmetrical temperature distribution, is easily demonstrable Connect a piece of steel wire across the terminals of a sensitive galvanometer and heat to redness any part of the wire by means of a bunsen flame So long as the flame is kept steady there is nothing unusual, but move the flame slowly in one direction along the wire, and the galvanometer gives a decided deflection, which is reversed on reversing the direction of motion of the flame The order of the effect is several microvolts, and can also be shown on a potentiometer Nickel wires also give good results, though copper, of course, conducts too highly

Apparently the motion of the flame produces an asymmetry of the temperature in the wire, a steep gradient where the flame approaches, and a slow gradient behind the flame According to modern statistical theory,[1] the Thomson potential is produced by a temperature gradient, not by a temperature difference, thus, although in this circuit the temperature differences may balance out, there is a greater gradient on one side than the other, and on the balance a potential difference remains

The phenomenon is very much more convenient for demonstration in a lecture than is the more usual method, where the heat absorbed by passing a current along a steep temperature gradient is detected In fact, the whole thing is so simple that I doubt very much whether it has not been noticed before, even though there seems nothing about it in the literature of the subject

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[1] Sommerfeld and Frank, "Reviews of Modern Physics", Jan 1931

Plankton Changes on the Coast of Ecuador

MR G SHEPHERD directs attention in NATURE of April 25 to the masses of yellowish brown plankton matter seen off the coast of Ecuador Some years ago the Chilian coast experienced a similar visitation, with much resulting trouble to locomotive boilers and condensing plant I had some of the water with the brown contents sent home and forwarded for examination to the Marine Biological Laboratory at Plymouth, where it was investigated and the results were kindly communicated to me

A diatom *Grammatophora* (probably *Maina*) was superabundant and was the chief cause of the trouble Other diatoms, *Lyomphora* (sp) and *Thalassiosira* (sp), were also common *Infusorians, Ceratium, Peridinium*, and *Pyzophacus* were frequent

DAVID WILSON-BARKER

Some Notable Women of Science.

By Eng Capt Edgar C Smith, O B E, R N

A CENTURY ago, on June 27, 1831, the eminent French woman mathematician, Sophie Germain, died in Paris at the age of fifty five years, and a few days later was buried in the Père Lachaise cemetery Her great women contemporaries were Mary Somerville (1780–1872) and Caroline Herschel (1750–1848), to whose names might be added, perhaps, that of Mrs Marcet (1769–1858), whose "Conversations on Chemistry" was the means of awaking the interest of Faraday in science Of the careers of Caroline Herschel, the devoted assistant of Sir William Herschel, and of Mrs Somerville, whose "Mechanism of the Heavens" and "The Connexion of the Physical Sciences" gave her a world wide reputation, everyone has heard, but Sophie Germain's story is little known Yet she and Mrs Somerville had much in common, and their minds were cast in the same mould When Mary Somerville, amidst the duties of her London home, was finding time to study the works of Lacroix, Biot, Euler, and Laplace, Sophie Germain was corresponding with Lagrange and Gauss, investigating the motion of the sand on Chladni's vibrating plates, and writing memoirs which gained for her the respect and admiration of both mathematicians and physicists Her place in history is that of the foremost of all French women of science

Mary Somerville, Caroline Herschel, and Sophie Germain were not, however, the first women in modern times to devote themselves to scientific studies Even in the seventeenth century, and amidst the disasters and miseries of the Thirty Years' War, we hear of the German astronomer Maria Cunitz, with the assistance of her husband, compiling new astronomical tables, which, after much delay, were published at Frankfort in 1654. Maria Cunitz died in 1664 To the seventeenth century also belongs the work of Jeanne Dumée, the French authoress of an unpublished memoir on the views of Copernicus, and of Elizabeth Koopmann, the wife of Hevelius, the celebrated astronomer of Dantzig Hevelius died in 1687, but for ten years his wife had been his ablest assistant, and after his death she published the two works, "Prodomus astronomiæ" and "Uranographia, seu firmamentum Sobescianum" Another German astronomer of the seventeenth century, George Eimmart, found in his daughter, Marie Claire, a valuable co-worker, and for him she made some hundreds of drawings of sunspots, comets, and eclipses

Among the women of science of the eighteenth century, one name, that of the Italian mathematician, Maria Gaetana Agnesi (1718–1799), stands out clearly When only eleven years of age she knew eight languages, and in her twentieth year she published a collection of ninety-one theses she had previously defended Her "Instituzioni Analitiche", published in 1748, long continued a valued text-book on the calculus, and is regarded as the first important mathematical work by a woman This work had been preceded in 1740 by the "Institutions de physique" of the remarkable Frenchwoman, Gabrielle-Émilie Chastelet (1706–1749), the friend of Voltaire, and to her we also owe a translation into French of the "Principia" of Newton This was not published until after her death While the names of these two distinguished women belong to the history of mathematics, those of Margarete Winckelmann (1670–1720), the wife of Gottfried Kirch, and of Nicole-Reine Étable de la Brière (1723–1788), the wife of Jean André Lepaute, belong to astronomy Madame Kirch, the wife of one astronomer and the mother of another, while at Berlin discovered a comet and made observations on the Aurora Borealis, and, after she became a widow, she published in 1712 a paper on the approaching conjunction of Jupiter and Saturn Madame Lepaute from an early age had displayed a taste for science, and when at the age of twenty-five years she married the celebrated horologist she at once became his collaborator She was also the friend of Clairaut and Lalande, and assisted them in the calculations on Halley's comet Her own observations are contained in the "Connaissance des temps", 1759–1774 The last years of her life were devoted to her husband, who was struck down with sickness, and she died at Saint Cloud a few months before him. Another woman of science of the eighteenth century was Dorothea Erxleben (1715–1762), who in 1742 published a work on the cultivation of science by women, and in 1754 was made a doctor by the University of Halle

Though to-day women are found working at every branch of science, it has been mainly in the realm of astronomy they have hitherto done their most notable work Following in the footsteps of Mary Somerville and Caroline Herschel, during the nineteenth century a succession of women made their mark either as observers or as writers on astronomy Maria Mitchell (1818–1889) was long the professor of astronomy and director of the observatory at Vassar College in the United States She was provided by the women of America with a large equatorial, and the observatory at Nantucket, now under the direction of Miss Margaret Harwood, was erected in her honour. Two other American women, Anna Winlock, who died in 1904 and Mrs Williamina Fleming (1857–1911), were connected with Harvard University Especially important were the writings of Miss Agnes Mary Clerke, who was born in County Cork in 1842 and died in London in 1907 Her sound judgment and her wide acquaintance with astronomical literature made her "History of Astronomy during the 19th Century" a most valuable book of reference This work first appeared in 1885, and was followed by her "System of the Stars", 1890, and "Problems in Astrophysics", 1903 Her most eminent woman contemporary in England was Margaret Murray, who in 1875 married Sir William

Huggins Like Caroline Herschel, Mary Somerville, Anne Sheepshanks, Miss Clerke, and Mrs Fleming, Lady Huggins enjoyed the distinction of being elected an honorary member of the Royal Astronomical Society

In other branches of science, mention may be made of the Russian mathematician, Sophie Kovalevsky (1850–1891), who studied under Weierstrass at Berlin, and in 1884 was made professor of higher mathematics in the University of Stockholm, Mrs Ayrton, the first woman member of the Institution of Electrical Engineers, and who was proposed for admission into the Royal Society, Marie Sklodowska, better known as Madame Curie, famous for all time as the discoverer of radium; and Dorothea Klumpke, who in 1893 was the first woman to obtain the doctor's degree in the mathematical sciences at the Sorbonne Her thesis was a study of the rings of Saturn It was when granting her the degree that M Darboux said that her work gave her a place beside Maria Agnesi, Sophie Kovalevsky, and Sophie Germain To this short sketch of some women of science other names might be added, but from what has been said it will be seen that France, England, Switzerland, Russia, Italy, Germany, and America are all represented, showing that the women of science, like science itself, have been confined to no one country or age

Diet and the Teeth *

AS a result of numerous experiments, Mrs Mellanby has shown that there is an intimate relationship between the structure of the teeth in dogs and the composition of the diet, more especially its vitamin D content (see NATURE, vol 125, p 604, 1930) In further work she has now demonstrated a relation between diet and the structure of the teeth in rabbits and rats, as well as one between diet and certain forms of dental disease in dogs and other animals

Defects of structure similar to those observed in the teeth of imperfectly fed dogs are common in other animals and have been found in horses, monkeys, rabbits, and ferrets A common defect is the presence of interglobular spaces in the dentine in fact, these spaces are so common that it is only their absence from teeth with smooth white enamel and their presence in large numbers in obviously imperfectly calcified teeth that has enabled one to say that they are abnormal structures and that their presence in a tooth otherwise well calcified indicates a certain degree of imperfect development or hypoplasia

The dentition of rabbits and rats differs considerably from that of the dog in the former, the permanent dentition shows continuous growth throughout life, in the latter, there is no temporary dentition, and the incisors grow from persistent pulps as in the rabbit, but the molars cease growing after eruption, as in dogs Young rabbits, about eight weeks old, were used for the experiments they were placed on a diet containing four parts of oats to one part of bran with 1 5 per cent calcium carbonate, 6 c c decitrated lemon juice were also given daily Without the latter, the animals developed scurvy, and without the calcium carbonate, good growth and health were not maintained The condition of the teeth on this basal diet was worse than when the calcium carbonate was omitted, since growth was better Except when vegetables were included, it was necessary to supply water also

The defects produced by this diet were as follows the enamel was thin and irregular and stained deeply with carmine, the dentine was thin and easily stained and contained many interglobular spaces, the odontogenetic zone was wide and irregular the jawbone was poorly calcified, consisting largely of osteoid tissue or osteoporotic bone

The addition to the diet of materials rich in vitamin D, such as cod liver oil, egg yolk, and irradiated ergosterol, induced good calcification of the teeth the two former, however, were not well-borne, death following after 7-8 weeks Smaller doses of cod liver oil, for example, 0 5 c c instead of 1-2 c c daily, with a supplement of 20 gm or more of cabbage, markedly improved general health and growth, and calcification was excellent Vegetables alone exerted only a small calcifying effect, although improving general health dandelion and clover were fairly effective, cabbage had little influence unless fed in large quantities, the allowance of oats and bran being at the same time reduced summer but not winter grass, was comparable to cabbage Swede-turnip, carrot, potato, and white turnip had little or no calcifying power As might be expected, irradiation of the animals with the mercury vapour lamp also improved the structure of the teeth

The amount of calcium and phosphorus in the diet and the calcium/phosphorus ratio are only of importance when the vitamin D intake is low In the basal diet, the ratio is 1 0 81 and the actual percentages of these elements relatively high It is of interest to note that rats fed on similar quantities of calcium and phosphorus have normally calcified bones When the calcium carbonate was replaced by phosphate the rabbits grew as well, but the calcification was much improved

The experiments on rats indicated that the defects of structure caused by a deficient intake of vitamin D were very similar to those found in rabbits, and that supplying this factor in the diet resulted in the development of perfect teeth

Although it has not been found possible to produce caries satisfactorily in the teeth of experimental animals, it has been shown that the development of the periodontal tissues in dogs and their subsequent liability to disease can be controlled by the diet. On a perfect diet the gingival region of the jaw is comparatively thin the subgingival epithelium is

* Medical Research Council Special Report Series, No 153 Diet and the Teeth an Experimental Study Part 2 A Diet and Dental Disease, B, Diet and Dental Structure in Mammals other than the Dog By May Mellanby Pp 94+28 plates (London H M Stationery Office, 1931) 2s 6d net

thin and regular and the corium is composed of connective tissue only The alveolar bone is compact On a diet deficient in vitamins A and D the gingival region is thick, the epithelium is hypertrophied and finger-like processes extend down into the corium, in which varying degrees of cell infiltration are present the alveolar bone is poorly calcified and consists in part of osteoid tissue Experiments proved conclusively that, whereas vitamin D controls the calcification of the jawbone, vitamin A is responsible for the perfect development of the soft tissues The gingival epithelium is thus comparable to epithelia in other regions which are abnormally developed in the absence of vitamin A The distinction between the effects of the two vitamins was clearly seen when vitamin A was supplied to one animal as mammalian liver oil (which contains no vitamin D) and vitamin D to its litter mate as irradiated ergosterol

Periodontal disease does not develop when the animals are fed on a diet containing abundant fat soluble vitamins, even though it is soft and pappy throughout life For prevention it is essential that the puppy be fed on a good diet for the first months after weaning if the intake of vitamins A and D is low at this period, a certain amount of disease almost invariably develops even although the diet is good for the rest of life When the tissues are properly developed owing to an adequate vitamin intake, very considerable resistance to disease is shown in later life even though the diet is incomplete for long periods After the disease has once appeared, further progress can be arrested by administration of large amounts of vitamins A and D, but a complete cure was not observed It may be concluded that diet acts primarily by controlling the developmental structure of the periodontal tissues and not by any direct or indirect effects concerned with bacterial decomposition in the mouth Prevention appears to be all-important once the tissues have developed abnormally, prevention of disease becomes extremely difficult

Caries has been observed only occasionally in the teeth of dogs, rabbits, rats, and monkeys, and attempts at its experimental production have usually failed Even when micro-organisms were fed for a long period, they were rarely found in the teeth In rabbits, however, softening of the exposed dentine on the occlusional surface of the molars was fairly frequent, especially when the animal had been fed on a defective diet, and organisms were found in the dentinal tubules in the majority of such teeth

When an erupted tooth is attacked by disease or suffers injury, it reacts by the production of secondary dentine Mrs Mellanby has shown that the structure of this new dentine, both in dogs and rats, depends on the amount of vitamin D in the diet, in the same way as that of the primary dentine The reaction only occurs in a living tooth As secondary dentine was not always found when the teeth were worn down by natural attrition, its production was stimulated artificially by filing the teeth and extracting them after this treatment had been carried out for six weeks It was found that perfect dentine was laid down when there was abundant vitamin D in the diet, that oatmeal interfered with the action of the vitamin, and that when the diet contained little, little or no secondary dentine, or dentine with many inter globular spaces, was produced

This experimental study has indicated certain lines of investigation in the problem of the arrest and prevention of caries in human beings, the conclusions reached will be described in Part 3 of this series

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Magnetographs obtained by Amundsen, 1903–1906 *

WHEN Captain Roald Amundsen started his voyage in the *Gjoa* through the North-west Passage in 1903, his first aim was the accomplishment of this great feat of exploration, and his second was the investigation of the magnetic conditions at and near the magnetic pole After his return from these successful enterprises, he published an account of his voyage, "The North-west Passage", in 1907, but his scientific material for a long time lay stored in the Historical Museum, pending its publication by a board of editors State grants were made at various intervals between 1908 and 1923 towards the preparation and publication of the results, and the preparation of the terrestrial magnetic data was finished in 1923, at that time further funds for the publication became difficult to obtain, but by restricting the scale of the work the funds were finally obtained for publication by the Geophysical Commission of the Norwegian Academy of Science at Oslo in its regular volumes. Part 1 is to deal with astronomy and meteorology, and Parts 2 and 3 with terrestrial magnetism The first to appear is Part 3, which consists of a repro duction of all the magnetographs obtained by the expedition, with only sufficient text (17 pages) to explain their nature It is "assumed that in some way or another funds will be obtained for the publication of Parts 1 and 2"—an assumption which geophysicists will earnestly hope to see confirmed

Amundsen occupied Gjoahavn on King William's Land (68° 37′ N, 95° 53′ W) from Sept 12, 1903, to Aug 13, 1905, and King Point on the coast of Alaska (69° 6′ N, 138° 8′ W) from Sept 3, 1905, to July 11, 1906 At Gjoahavn the variometer house was constructed out of the packing-cases of the expedition (specially prepared free from iron for this purpose) and the instruments were set up by Oct 31, 1903, and continued working until June 1, 1905, at King Point the dates were Oct 17, 1905, to Mar 31, 1906, the variometer house there being constructed of drift timber. The houses at both places were partly dug into the ground, and covered over with sand; even so, the temperature inside them underwent great changes, at Gjoahavn from

* Geofysiske Publikasjoner, vol 8, pp 17+191 plates (Oslo, 1930.) 20 00 kr.

5° C in summer to −26° C in winter, with a daily range of about 1° C, at King Point they were still greater, the daily range being 6° or 7° C. Unfortunately, the registering instruments were not well compensated for temperature.

The data have been prepared under the editorship of Nils Russeltvedt and Aage Graarud, and the difficulty of their task must have been very considerable, in inferring temperature coefficients, base line values (frequently altered), and scale values. In stating the latter, they do not indicate in what unit the ordinates are measured, but it appears to be 1 mm. The scale values (per mm.) of the three instruments, which were of Eschenhagen pattern, all registering on one drum, were for declination (in force units) 17γ, in horizontal force 12γ, and for vertical force 5γ until about September 1904, and thereafter 22γ; at King Point the corresponding values were about 20γ, 12γ, and 23γ. In the vertical force record, 1° change of temperature made an apparent change of 140γ in the force. The normal time scale was 20 mm. per hour; in quick runs it was twelve times as great.

The magnetographs show records and base lines for the three magnetic elements and for the temperature. Before reproduction the times were marked on the hour lines automatically registered across the sheets, the date was written on, and the various traces were indicated by letters at one end. It is to be regretted that on sheets which show disturbance, when some of the traces often crossed one another, the letters were not added elsewhere also; in the reproductions it is often not easy to be sure of the identity of each trace on such days, while on the originals the difficulty is likely to have been much less.

The sheets are reduced on reproduction in the ratio 3·46 to 1, so that four can be got on to a quarto page; the reproduction is very good, and the collection should be of great value to those who wish to make intercomparisons between the changes of the earth's field near the auroral zone and elsewhere. The curves indicate the presence from time to time, in the neighbourhood of these stations, of intense overhead currents, usually somewhat to the south, and sometimes flowing eastwards, at others westwards. This would suggest that both stations are within the auroral zones, and it will be of interest to learn later, from Part 1 or 2, whether auroræ usually appeared to the south.

The magnetic results of the Amundsen expedition would have been of still greater value had they coincided in time with Birkeland's magnetic and auroral expeditions of 1902–3, the results of which were published by him in 1908 and 1913. Though this was unfortunately not so, their value will enhance, and be enhanced by, Birkeland's data, and they will form an important link in the chain of evidence which will lead to the elucidation of the very difficult problems presented by magnetic disturbance.

Obituary.

MR. C. T. HEYCOCK, F.R.S.

THE death of Mr. Charles Thomas Heycock, on June 3, removes from among us one who had gained the affection of generations of Cambridge men and who was a pioneer in an important branch of inorganic chemistry. Heycock was the younger son of Frederick Heycock of Braunstone, Oakham, and was born on August 21, 1858; he received his early education at the Grammar Schools of Bedford and Oakham, and entered King's College, Cambridge, as an exhibitioner in 1877, taking the Natural Sciences Tripos in 1880. For many years he taught chemistry, physics, and mineralogy for the Cambridge examinations, and in 1895 he was elected to a fellowship at King's College, becoming a college lecturer and natural sciences tutor in the following year. He was elected a fellow of the Royal Society in 1895, and was awarded the Davy Medal in 1920 for his work on alloys. His original work on the metals attracted the attention of the Goldsmiths' Company, who endowed a readership in metallurgy at Cambridge; he was appointed to this office in 1908 and held it until his retirement in 1928. He was admitted to the Livery of the Goldsmiths' Company in 1909 and to the Court in 1913; he acted as Prime Warden during the year 1922–1923, and took a keen interest in the work of the Company's Assay Office.

Notwithstanding the exacting character of his work as a Cambridge coach, Heycock joined with his lifelong friend, F. H. Neville, in a comprehensive study of the metals and their alloys; this partnership, which was only dissolved by the death of Neville in 1915, led to a remarkable series of papers in which novel directions of investigation were mapped out and developed. The first of these joint papers was published in 1889 and dealt with the depression of the freezing points of metals brought about by others dissolved therein; in this and later papers it was shown that the addition of small amounts of a second metal depresses the freezing point of the first to an extent (1) directly proportionate to the weight of metal added and (2) inversely proportionate to the atomic or molecular weight of the added metal. Raoult's law for ordinary solutions was thus extended to alloys, and a method indicated for calculating the latent heat of fusion of a metal by the application to the freezing point depressions of the now well-known van't Hoff equation. At the outset, mercury thermometers were used in the temperature measurements and only alloys of low melting points could be studied; the introduction by H. L. Callendar of the platinum resistance pyrometer made it possible to extend the scope of the investigation to metals of high melting point. This was done with the assistance of Dr. E. H. Griffiths. During the carrying out of the programme thus extended, the melting points of many of the metals in the pure state were determined; later observers have confirmed the

substantial accuracy of most of the melting points given by Heycock and Neville

The study of the melting points of dilute solutions of one metal in another led naturally to the determination of the melting points of mixtures of metals in all proportions, a technique was developed by which the results, interpreted by means of the phase rules of Willard Gibbs and Roozeboom, were supplemented by the microscopic examination and photography of polished and etched sections of the solidified alloys The most detailed piece of work done on these lines was that on the copper-tin alloys, which formed the subject of the Bakerian Lecture before the Royal Society in 1903, the two collaborators also made a minute study of many other binary and ternary alloys They had already shown in 1897 that X ray photographs of thin sections of alloys could provide valuable information as to the physical state of the component metals

The major part of Heycock and Neville's experimental work was carried out in a small laboratory in Sidney Sussex College and, owing to the many other duties which fell upon the two partners, much of it had to be done late at night and in the early hours of the morning It may seem surprising that such a quantity of data of enduring value could be collected under such conditions but both men were enthusiasts, both possessed an exquisite sense of technique, and both were meticulous in their striving after accuracy

Heycock was an excellent lecturer, his whimsical mode of addressing a class sustained an interest in inorganic chemistry during a period when that subject seemed in danger of eclipse by the rapid advance of organic chemistry He had few equals as a teacher in the laboratory, his deliberate method of working and his sarcastic denunciation of slovenliness inspired respect and awakened the spirit of emulation Much of the work of organising and planning the numerous extensions of the University chemical laboratories during the last twenty-five years fell upon him, and he carried it out with characteristic care and thoroughness His physical vigour found further expression in his devotion to the Volunteer movement from quite early days, and during the War he was appointed Lieutenant-Colonel of the Cambridgeshire Regiment

In his domestic life, Heycock was thoroughly happy, his house was the meeting place of undergraduates and seniors alike, and its cheerful hospitality is a delightful remembrance to vast numbers With his death we have lost a scientific man of the old type who would spare no pains or time in eliminating error from an experimental observation, many of us have also lost a shrewd and wise counsellor and one of the most staunch and loyal of friends W J POPE

DR A T MACCONKEY

DR ALFRED THEODORE MACCONKEY who died on May 17 at the age of seventy years, was known to bacteriologists in all parts of the world as the originator of the medium which bears his name After taking his medical degrees in 1889, he settled in practice for some years, but relinquished it in consequence of an illness, and decided to devote himself to research work in bacteriology

MacConkey was associated for a time with Washbourn and Eyre in the laboratories of Guy's Hospital, his old school, and afterwards with Boyce in the Thompson-Yates laboratories in Liverpool His appointment about this time as assistant bacteriologist to the Royal Commission on Sewage Disposal, the working headquarters of which were at Leeds, determined the trend of his researches during the early years of the century The problems that called for solution fascinated him, and his interests were soon deeply engaged in the technical part of the work. During the period 1900–9, he published a number of papers, which embody his pioneer studies upon the classification of the lactose-fermenting bacteria of intestinal origin, and upon the differential criteria of this group and their significance as contaminants of water, milk, and foodstuffs

The introduction of MacConkey's bile-salt medium put into the hands of bacteriologists a simple and effective tool for the separation of the typhoid-dysentery group of bacilli Bile-salts had been added to media so early as 1889, and MacConkey's first experiments with them were made in 1897, in 1900 he was using bile-salt lactose agar for the purpose of isolating *B typhosus* and *B coli communis* In 1902, Grünbaum and Hume suggested the addition of neutral red as a colour indicator for colonies that either do or do not ferment lactose, and MacConkey adopted this improvement in the method He was one of the first to appreciate the importance of noting and comparing the biochemical activities of the intestinal group of bacilli with the object of defining their specific characters and their relationships Thus, he based a useful classification of the coliform group upon the ability of its members to ferment saccharose and dulcitol

In November 1901, MacConkey joined the staff of the Lister Institute, London, as an assistant in the bacteriological department His transference soon afterwards to the serum department of the Institute at Elstree, then under the charge of the late Prof George Dean, directed his energies to the solution of the problems which surround the preparation of toxins and antitoxins In April 1906, he became the head of the department, and he remained at Elstree until his retirement in April 1926, at the age of sixty-five years He continued the early work of his colleague, Dr J C G Ledingham, on serum concentration, and developed the technical processes for refining and concentrating antitoxic sera There are workers in many countries who owe their practical knowledge of the subject to the information which MacConkey freely put at their disposal In 1912 he contributed to the reports of the Plague Research Commission in India an interesting paper on the production and titration of anti-plague serum, in which he showed that the specific antitoxin can be concentrated by the usual methods, and that it is associated with the

pseudo-globulin fraction of the serum proteins He had previously made a comparative study of the antigenic relationships of the plague bacillus and the pseudo-tubercle bacillus and was able to confirm the close kinship of these bacteria, as judged by the results of precipitin and immunity tests

In 1912, MacConkey published a remarkable paper which indicated a seasonal change in the potency of diphtheria toxin when produced in regular weekly batches His curves certainly seem to show a significant increase of toxicity during the winter months as compared with the level attained in the summer Moreover, he directed attention to the close correspondence of the toxin curve with that of the prevalence of diphtheria in London and elsewhere These observations are unique, and the present writer is disposed to believe that they are related to variations in the health and susceptibility to infection of the stock of guinea-pigs from which the test animals were drawn

During the years of the War, MacConkey put his energies without stint into the task of enlarging and organising his department to meet the increasing demands made upon it by the army authorities for tetanus antitoxin, antidysentery serum, and antimeningococcus serum He took a keen interest in the prophylaxis and treatment of tetanus by means of antitoxin, and he published several papers on the subject , in some of them he reviewed the observations of workers in many countries, and in others he gave an account of experimental work carried out by himself and his colleagues He served as a member of the War Office Committee for the investigation of tetanus In his published articles he put forward a strong plea for devoting special attention to the early signs and symptoms of tetanus, on the ground that the antitoxin is likely to influence the disease only when administered as soon as the symptoms are recognisable The limited response to his appeal and the scanty information which came to hand disappointed him, but it is probable that he had not sufficiently appreciated the difficulty of discriminating between the premonitory subjective symptoms of tetanus and those which were attributable to sepsis and to the nervous strain from which the patients were suffering

MacConkey, as the writer has good reason to know, was essentially a man of a kindly disposition His sense of duty was so strong that, during the trying years of the War, he suffered from the strain to an extent which weakened his resistance and laid the foundation of a cardiac disability from which he never really recovered G F P

MR E TORDAY

THE death, at the age of fifty-six years, of Emil Torday, which occurred on May 9, at his London home, removes one of the most distinguished of African ethnologists A Hungarian, his adventurous spirit led him to the heart of the Dark Continent some thirty years ago He there acquired a great affection for its savage native inhabitants, and by his personality inspired in them an equal affection for himself

Deeply interested in native manners and customs, Torday made these his life's study To this end his wonderful linguistic talents helped very considerably He spoke seven European languages and eight of the tongues of Central Africa His works on the ethnography of the Negro, written in collaboration with Capt T A Joyce of the British Museum and published by the Belgian Government in French, " Les Bushongo " and " Peuplades de la forêt et Peuplades des prairies ", are surely models to be followed by future students of native life In lighter vein, but scarcely less informative to the general reader, is his " Causeries congolaises ", published in Brussels in 1925 In English he published " On the Trail of the Bushongo " and " Camp and Tramp in African Wilds ", besides contributing numerous articles and reviews on African ethnology to the *Journal of the Royal Anthropological Institute*, *Man*, and *Africa* Only just before his death he had completed his monumental volume on " African Races " for the series of works upon descriptive sociology founded by Herbert Spencer, which was reviewed in NATURE of May 2, p 655

Of Torday's personal courage a word must be said Upon one occasion he stepped in between a party of defenceless children and the warriors of a hostile tribe who had their bows already drawn to annihilate the children of their national enemies Torday, unarmed, stepped in between the warriors and their victims, and, by his utter disregard of personal safety, saved the lives of innocents and the commencement of an inter-tribal feud which would probably have lasted to this day

The loss of Torday, could it be made known to them, would most certainly be regretted by many tribes in Central Africa It will as certainly be regretted by scientific workers in Europe One who was privileged to accompany him for two years upon his last great Central African journey mourns his loss not least of all

M W HILTON SIMPSON

MR TORDAY'S contribution to the science of African ethnology was twofold His publications have already been mentioned , they constitute a record of the highest importance But he was also distinguished as a practical field worker , and the ethnographical collections from the Belgian Congo, all carefully documented, with which he enriched the British Museum between 1907 and 1910, are of outstanding excellence Both in quantity and quality they are unrivalled among our African collections and it is not too much to say that the study of them is essential for anyone who would understand the high level of refinement in decorative and textile arts of which the Bantu are capable In performing this signal service to the nation, Torday has incidentally achieved a fitting memorial to himself and his labours, which will increase in value with the passage of time He worked for some years in an unofficial capacity at the British

Museum, arranging and labelling his own and other collections, and his deep knowledge of African matters was always placed freely at the disposal of the staff

Mr Torday was also one of the most active members of the Royal Anthropological Institute, attending its Council meetings regularly, helping in the improvement of the library, reading papers, and rendering invaluable and unselfish service in a variety of ways In 1929 the Institute awarded him the Rivers Memorial Medal for anthropological work in the field Torday was also a Chevalier of the Order of the Crown of Belgium, and by his own country he was awarded the Great Gold Medal for Literature and Science, a rare distinction

By his death African ethnology loses one of its most brilliant, sincere, and devoted students, and his friends the privilege of a delightful and stimulating personality H J Braunholtz

News and Views.

It was a remark of Lord Oxford's, that the business of biography is the vivid delineation of a person, and that for its success one of its obvious conditions is that the person delineated should have the power of permanently interesting his fellow men Of all men of science, Faraday assuredly was such a person, his rare mental qualities, combined with a singularly refined moral nature, making him as worthy a subject for the biographer as a Pasteur or a Lister Some of the characteristics of Faraday were admirably brought out by Dr R L Mond, who on June 11 delivered the Second Spiers Memorial Lecture to the Faraday Society Referring to the approaching celebrations of the centenary "of one of the most fruitful conceptions of the human mind", Faraday's discovery of electro magnetic induction, he said many, well qualified, will comment on the origin of this conception, its development and application, but there is one aspect of this triumph of the human mind which deserves special consideration, namely, the study of the conditions and of their influence on the individuality which makes the conception a possibility This naturally led Dr Mond to refer to Faraday's early environment One dominating influence was his association with the Sandemanian form of belief, which combines (like that of the Quakers and Unitarians) a great simplicity of mind with exemplary conduct and love and esteem for your fellow members Next came the influence of books, the writings of Bacon, of Dr Watts, of articles in the Encyclopædia Britannica, and of Mrs Marcet's book on chemistry Faraday also found both assistance and inspiration by his association with the ardent spirits of the City Philosophical Society, and then came the turning point in his career when he was engaged by Davy, a step which in turn led to his memorable tour on the Continent, "a high school of incomparable value"

"But", said Dr Mond, "what can we learn from Faraday's career, that we can usefully apply both to the search for new knowledge, the Perfection of what we all possess, and the Perfectibility of those who are devoting themselves to this research?" This question led to the examination of Faraday's views on education Giving evidence before the Public School Commission in 1862, Faraday said, "I do think that the study of natural science is so glorious a school for the mind that, with the laws impressed on all these things by the Creator, and the wonderful unity and stability of matter, and the forces of matter, there cannot be a better school for the education of the mind" Reverence for the beauties of Nature and the laws which control them, in Faraday was combined with a reverence for great thinkers and the truths they were unfolding One of the problems of to day is how to guide the footsteps of those whom we hope will emulate our great prototype, and the task often is "how to bring the great pupil to the great teacher" Modern civilisation has evolved an intellectual machine which, from heterogeneous raw materials, attempts to produce a uniform product, but we shall have to provide opportunities where the young mind can develop, untrammelled by any hard and fast system, under the ægis of a wise and kind direction, and where every suitable aid to self development and facilities for scientific research are amply provided

The English Channel was crossed for the first time by a British built glider with a British pilot, Mr Lissant Beardmore, on June 19 The pilot, having been towed by an aeroplane to a height of about 14,000 ft above Lympne, at 4 30 p m released his machine and glided in a continuously falling path, landing at St Inglevert aerodrome just after 6 p m It is unfortunate that he will not be officially recognised as being the first person to glide the Channel, since he was prevented from applying to the British Gliding Association for the proper observation of his performance by the anomaly that he did not hold the most advanced of the certificates awarded to glider pilots, and was therefore not judged competent to undertake the feat Herr Kronfeld, on a German-built machine, accomplished the same flight, in a similar manner, under official observation, on June 20 He flew from France to England, and thus becomes the holder of the official distinction He afterwards made a return glide from Dover to St Inglevert, being again raised to the required height by an aeroplane that had accompanied him, and qualified for the *Daily Mail* prize for the first glide across the Channel in both directions on the same day

The executive committee of the Committee on Intellectual Co operation of the League of Nations at its April meeting considered a request from the Chinese Government for co operation with the League organisations in the intellectual and scientific field The principal suggestion related to the exchange of university professors The Chinese Government proposed to send to Europe students, writers, philosophers, historians, and archæologists, and invited the League to organise tours in China for specialists in medical,

political and natural science, and legal questions A request was also made for professors of geography and geology for the University of Nanking, particularly of English, Austrian, Scandinavian, or Swiss nationality, who could give instruction in English A further request for co operation considered at the same executive committee meeting related to the better utilisation of leisure—a problem which is assuming ever greater importance as a result both of the reduction in hours of work and of the tendency to mechanisation and specialisation of labour The request was received from the International Labour Office, and the Committee authorised the director of the Institute to accept the offer of the International Labour Office and assist in the study of the conditions of popular arts and public libraries in various countries, their resources, and accessibility to the workers, by collecting complete information on these subjects in relation to the problem of workers' leisure as a basis for comparison, conclusions, and appropriate action

SINCE the old days of driving sheep from the Argentine to the southern sheep stations of Patagonia, no drive can compare, for duration and extent, with the reindeer movement now in progress in Canada In 1929, 3000 reindeer were purchased in Alaska by the Canadian Department of the Interior, and in December of that year the work of herding the animals from the west coast of Alaska to the eastern side of the Mackenzie River was begun In the spring of 1930, the herd had reached the Hunt River in the Kotzebue Sound area, where a halt was made for the fawning season During the summer the herd, with its 2000 fawns, remained in this region, until the second stage of the drive began late in 1930 The movement was then continued in a north easterly direction toward the pass leading to the Colville River It was reckoned that the second fawning season on this long trek would be passed in the delta of that river, so that probably only about 400 miles now separate the herd from its new range to the east of the Mackenzie delta Here it is expected to arrive during the winter of 1931–32

THE *Quarterly Bulletin* of the Imperial Bureau of Animal Genetics, vol 2, No 2, just issued, contains a useful summary of recent developments in fur production and reindeer breeding Since the first fox farms were established in Prince Edward Island, this industry has grown largely in Canada, and attempts, not very successful, have been made to domesticate other species Questions of fur production from many animals are discussed, and it is pointed out that the most important fur bearer in the world is the rabbit, because it breeds rapidly and well in captivity and can be produced genetically in a great variety of colours The reports of the Porsild brothers on the possibilities of reindeer breeding in Arctic Canada and the problems of reindeer husbandry are considered at some length The Mackenzie delta and Great Bear Lake regions are found to be capable of supporting large herds, hence the reindeer movement Experiments are already being made in crossing the reindeer with the large woodland caribou of Newfoundland Other items in this bulletin are a list of literature on reindeer, reviews of books on fur farming and rabbit breeding, and notes on the domestication of mink A bibliography on fur breeding will shortly be ready and obtainable from the Bureau in Edinburgh for 1*s* One on the biology of the fleece has already been published at 2*s* 6*d*, and another on the genetics of the rabbit is in preparation

GERMAN oilfield developments have been prominent in the press lately, consequent on the Royal Dutch Shell Company's active interest in the operations, of which a report appeared in the *Times* of May 22 For some time past, both German and American companies have been engaged on exploratory work, but the results have scarcely justified the claims originally made as to resources, though there would seem to be evidence of petroleum occurrence over a wide area in the north-west From a technical point of view, one of the best recent accounts of the fields is given by Von E Krenkel in the April number of *Die Naturwissenschaften* For all practical purposes, the chief developments have been in the Hanover region within a radius of some fifty kilometres from that city, and the features of geologic interest are the Zechstein salt bodies This region includes the Oelheim, Hänigsen and Wietze fields among others, from which there has been a steady though not spectacular production, the prospective total for this year for the region as a whole is estimated at 200,000 tons Unproved areas lie to the north (Oldenburg) and elsewhere in the Hanover province, already noted for the famous Limmer and Vorwohle rock asphalt deposits It is clear that although comparable salt structures with those of certain other oilfields are known in this part of Germany, they are not, in the present state of our knowledge, significant of the existence of oilpools of magnitude

A LARGE proportion of the current issue of *Africa* (vol 4, pt 2) is devoted to the consideration of matters of practical import Instructions for missionaries who have opportunities for extended ethnographical observation, which have been prepared by Dr Westermann, and suggestions for the teaching of hygiene to women, by Miss Mary Blacklock, have a grasp of the problems in their respective fields which gives them a claim to careful consideration There are, however, two other communications which call for more than passing mention, as illustrating the principles, recently discussed by Prof Malinowski and others in the pages of *Africa*, which bear on the value of scientific study of native institutions in relation to practical problems It was urged that in a changing Africa neither an academic nor an antiquarian interpretation of the field of inquiry is likely to have any practical effect, but that what is needed is a study of the functioning of existing institutions as integral parts of a culture considered as a whole

IN the first of the two communications to which we refer, Mrs A W Hoernle, in considering the native conception of education in Africa, points out the

significance of age and sex in determining occupation, the function of the family as a social unit, and the place of initiation in ensuring tribal continuity of tradition through the instruction given in the initiation schools, and discusses the bearing of these factors upon the problem of educating the native in present conditions Mr D S Knak, in his study of the influence of European civilisation on African family life, deals with native marriage on similar lines, referring particularly to native as opposed to European forms in marriage and the difficult problem of polygamy The two papers may be commended to the attention of those who are prepared to consider impartially the respective claims of the scientific student and of the 'man on the spot' with practical experience but unbacked by specialist knowledge, to speak with authority on native problems which call for solution both now and in the immediate future

IN his presidential address to the Devonshire Association on June 23, the Bishop of Plymouth gave an admirable, but necessarily brief, survey of the history of religious houses in Devonshire Unfortunately, Devonshire had no chronicler in its monasteries to emulate, even *longo intervallo*, Jocelin of Brakelond, and, as Dr Masterman was constrained to admit, the actual history of most Devonshire religious houses has passed into oblivion Yet for five centuries they played a large part in the religious and social world of Devonshire, if we may judge from the contemporary evidence of a writer whom the Bishop quoted, even though he dealt with another county It would appear that the monks dealt paternally with their tenants, if less efficiently than the landlords who succeeded them, and it is significant that among the demands of the Cornish and Devon rebels of 1549 one was that two of the chief abbeys in each county should be re established At the time of their abolition, the number of religious houses in Devonshire ranked sixth among the English counties, ten being included among the greater monasteries, that is, monasteries of which the income exceeded £200 (about £3000 in modern currency) The suppression seems to have been carried out by peaceful negotiation In nearly every case the abbot and his brethren received pensions Of Devonian monasticism one relic remains in 'the Abbot's Way', the rough track across Dartmoor which once linked Buckfast and Plympton with Buckland and Tavistock, marked by broken crosses set up to guard the traveller from the pixies that haunt the moor

THE advantage of short over long wave transmission for broadcasting is that it is much less affected by atmospherics and fading In some parts of the world, for example, in Central and South America, these causes prevent reception of long wave stations sometimes for months at a time This probably accounts for the great popularity of short wave broadcasting in America At present, according to *World Radio* for June 12, there are thirty-seven firms engaged in the manufacture of short wave receivers. These receivers range from the one valve to the thirteen valve set Home-built sets are almost a thing of the past, manufacturers are now competing with one another and the prices are very reasonable Combination receivers which allow the listener to tune in at all wave lengths between 14 and 550, the latter being the upper limit of the American broadcast band, are the most popular At present there are twelve operating short wave broadcasting stations in the United States and a few in Canada and Mexico All relay musical programmes and can be heard in the United States Distant reception is also to be had from all parts of the world The Rome station on 25 4 metres is heard best in the eastern portion of the country, and the station at Saigon, in French Indo China, in the western section It is noticed that the Rome station does not fade so early in the evening as stations farther north Many new stations are being built, broadcasting on short wave lengths only

IT is interesting to notice that when the London United Tramways were faced with the necessity of a heavy expenditure in connexion with their tram track and vehicles, for about seventeen miles of their tramway system in Surrey they decided to adopt trolley bus working The first trolley bus service in London started on May 16 and has given satisfaction This type of transport is common in many towns both in Great Britain and abroad, and the number of trolley buses in operation is increasing very rapidly In the *English Electric Journal* for June an account is given of various types of 'English Electric' trolley buses They run smoothly and quietly, and are capable of rapid acceleration and powerful braking When fully loaded they are capable of a speed of about thirty miles per hour on the level and eighteen miles per hour on a five per cent gradient The maximum operating acceleration is three feet per second per second, which allows twenty miles per hour to be attained in ten seconds, in a distance of about sixty yards In the Twickenham Teddington route the vehicles are double decked 56-seaters They are fitted with an 80 horse-power 500 volt motor, and the speed control is effected by a pedal which actuates an electric controller Three braking systems are provided, hand, rheostatic, and vacuum, the two latter being operated in succession from one pedal Retardation can be effected at eight feet per second per second for ordinary stops, and at twelve feet per second per second for emergency stops, these rates being uniformly maintained until the vehicle comes to rest Thus in an emergency a bus that is running at thirty miles an hour can be brought to a standstill in about eighty feet

WHEN the last estimate for the Reichskuratorium fur Wirtschaftlichkeit was passed by the Reichstag, a recommendation was put forward that in all investigations on rationalisation carried out at the public expense the human factor should receive special study An official conference to discuss rationalisation and the human factor was held in Berlin on Feb 27 and 28, the conference being opened by the president of the Board of Trade and a representative of the Ministry of Labour The programme was divided

into two sections, the first, on the optimum organisation of labour, being opened by papers on recent discoveries in the field of labour psychology (Dr Lipmann), practical investigations to ascertain the optimum organisation of labour (Dr Ascher), and measures taken by employers to introduce the optimum organisation of labour The discussion was unusually animated, and was guided by the Reichskuratorium by means of statements, opposing statements, and syntheses of the communal and individual points of view The second section was concerned with vocational selection and training The discussion in both sections indicated the divergent views held on rationalisation, and also the ease with which the gap could be bridged by eliminating misunderstandings due to differences of language and definition, and by concentrating on views common to all parties The Reichskuratorium is following up the conference by a closer study of the special fields, and their investigation by the central organ of the German rationalisation movement should ensure that they are studied less from the personal than from an unbiased scientific point of view

IN his address on "Industrial Administration" before the Association of Technical Institutions, Mr A S Comyns Carr referred to the scant attention which industrial administration had received from the majority of those engaged in industry, in spite of its necessity in every industrial enterprise This want the Institute of Industrial Administration is endeavouring to supply Regarding industrial administration as the co ordination and control of all the activities of an industrial enterprise, from the purchase of the raw material to delivery of the finished product, the Institute seeks to provide the industrial administrator or general manager with sound information on the principles which his experts should follow The effort to establish industrial administration among the recognised professions is already leading to the recognition that management occupies a unique position in industry That position involves responsibility not merely to the proprietors of the business but to those employed by it, and also towards the public

THE Institute of Industrial Administration sets as its first aim the establishment of industrial management as a responsible profession The promotion of research into the principles of management is a further main line of advance, particularly in Great Britain, where the spirit of secrecy has greatly hindered the interchange of information on management methods and principles, which is a first step towards raising the general standard of administration Referring to the educational work of the Institute, Mr Comyns Carr asserted the importance of teaching the principles of administration Once these are understood, the appropriate system for meeting with a given set of conditions will easily be developed In discussions on the need of first class administrators for industry loose references to the importance of personality tend to obscure the need for training Personality is not a substitute for training, and the Institute of Industrial Administration insists that management requires real qualifications and not the accidents of financial interests or family relationships

IN view of the great development of the work of the Long Ashton Research Station of the University of Bristol, the governing body of the Station has recently formulated a new scheme of membership of the Station This scheme provides for three classes of members, on a basis of varying rates of annual subscription to the Station, the privileges of the members in the three classes being graded according to these rates Class A, on a subscription of £1 1*s*, allows the member to consult the staff without fee, to purchase at preferential rates any material of the nature of buds, grafts, cuttings, or plants of any varieties of fruit, to submit, without charge for examination, not more than six samples of cider and perry annually, and to have priority over non subscribers in respect of any advisory services Class B, entailing a subscription of £2 2*s*, includes all the privileges of Class A, also to receive one copy of reprints of papers published by the staff, and to participate in the seedling distribution scheme, which has been adopted after consultation with the Ministry of Agriculture and Fisheries and the Horticultural Trades Association Class C for which the subscription is £5 5*s*, differs from Class B only in the seedling distribution scheme

THE original air maps of the United States, which were first published a few years ago, were known as strip maps, because, individually or in series they covered strips of territory 80 miles wide between one airport and another Of the 42 sheets planned, 22 are now completed and 7 are in hand The Annual Report of the United States Coast and Geodetic Survey for the year ending June 30 1930, announces a new project in air maps Since 80 per cent of flying is now over routes which do not follow the airways provided with strip maps, it has become necessary to have a map covering the whole country This will be provided in 92 sheets excluding Alaska It will be based on the United States topographic map, which, however, is available for only about 40 per cent of the country The Report announces also that financial resources have now been provided for the completion of the topographic map in some twelve years time This will allow the air map to follow rapidly

AT a meeting of the Royal Society of Arts on May 6, the Earl of Crawford and Balcarres made a strong plea for the retention of the natural and artificial beauties of England, in an address upon 'The Preservation of the Country side The appositeness of the speaker's remarks and the need for his criticism of many tendencies of present day development were emphasised by a series of lantern pictures of England spoilt and unspoilt The text of the address was "orderliness, tidiness, and discipline", and the illustrations showed how much could be accomplished by the application of these qualities, none of which was incompatible with the picturesque and the inspiring Amongst the special points dealt with were the litter nuisance, the choice of building materials, ribbon

development of building (a serious and very important issue), and the value of trees. The address and the comments made upon it by various speakers, including Mr. Cass Gilbert, the architect of the Woolworth Building in New York, appear in the *Journal* of the Society for June 5.

As announced in NATURE for March 7, the 'Dechema' (Deutsche Gesellschaft fur chemisches Apparatewesen) held its general meeting in Vienna on May 28 and 29 at the same time as did the Verein deutscher Chemiker. The scientific proceedings were well attended, and the papers which were communicated on 'The Separation of Liquids and Solids" aroused wide interest. In all, twelve papers were communicated dealing with filtration in the laboratory and on the technical scale, the latter being naturally in the majority. We are informed that this interesting series of lectures will shortly be published in volume form of the 'Dechema' Monographs. On May 30 those taking part in the general meeting were able to visit the almost completed new Institute of Chemical Technology of Inorganic Compounds, a part of the Vienna Technical High School. This Institute provides an almost ideal solution of the problem of enabling the students to work with apparatus which corresponds to factory scale conditions.

IN connexion with the International Illumination Congress which is being held in Great Britain next September, the General Council of the Congress has issued a booklet on the origin, organisation, and work of the International Commission on Illumination, under the auspices of which the Congress is being held (International Illumination Congress, 1931, 32 Victoria Street, London, S.W.1). Its object is the provision of an international forum for all matters relating to the science and art of illumination, and the International Commission at the present time has national committees in Austria, Belgium, Czechoslovakia, France, Germany, Great Britain, Holland, Hungary, Italy, Japan, Sweden, Switzerland, and the United States. Meetings of the Commission are held every three years, the last being held in the United States in 1928. This meeting was attended by 71 delegates from nine countries, while the Congress held just previously was attended by 514 delegates. Among the more important work of the future is that of securing international agreement on the fundamental bases of illumination, the standardisation of illumination materials, and international agreement on illumination legislation. Added to this, is the necessity for research and the education of public opinion to the value of good lighting. The booklet includes an article on "The International Commission on Photometry", the names of the officers of the Commission, and lists of the papers read in 1921, 1924, 1927, and 1928.

THE Report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1930–1931 is to hand, and, as in the past, shows a creditable record of progress. This constitutes the tenth session during which provision has been made for instruction in petroleum technology, and it is significant of the farsightedness of the sponsors of the courses involved that little material departure from original schedule has been found necessary during that time. Students are drawn principally from the clerical, distributive, and technical branches of the industry, and the average number per session, taken over the whole decade, who have profited by the teaching at the Institute, is one hundred. During last session, courses were provided on general technology of petroleum, on internal combustion engines and lubrication, on chemical and physical properties of petroleum and its examination, on the applications of engineering to industry, and on construction of works. The past session was also marked by a striking increase of the number of student hours, from 2876 previously to 4144, a testimony to the keenness of the members of these classes and a source of gratification to the teaching staff.

AN important congress of naval architects will be held in Paris on June 29–July 4 at which papers will be read dealing with shipbuilding, marine engineering, and civil aviation. The meeting will be confined to members of the Institution of Naval Architects (London) and members of the Association Technique Maritime et Aeronautique.

THE United States Government sets a good example in the matter of industrial statistics. Much of interest can be culled from even the dry bones of such documents as "The Coke and By Product Tables for 1929", compiled by the U.S. Bureau of Mines, Coal Division (Washington, D.C.). It throws interesting light on the immense American carbonising industry. In 1929, nearly sixty million tons of coke were produced – an increase of 50 per cent on the figures of 1915, but the proportion made in by product ovens had grown in that period from one third to 90 per cent of the total. The coke is mainly used as metallurgical fuel, but an increasing proportion is going into the domestic 'furnace'. The immense quantities of tar cannot be absorbed for manufacturing purposes, and more than one-half is consumed as fuel, mainly in the steel works, the average price being 5 cents a gallon. The surplus gas is used mainly as industrial fuel and commands an average price of 16 cents a thousand cub. ft., but up to 29 cents for use as town's gas. These figures are instructive in indicating the limits set by economic circumstances to the extension of coal carbonisation.

THE observatory of De Bilt lies about 40 miles east of the Hague. The seismological section, founded in 1904, possesses a pair of Galitzin's horizontal seismographs and his vertical seismograph with the usual magnetic damping and galvanometric registration, one of Wiechert's astatic horizontal pendulums, and a pair of Bosch horizontal pendulums. The first number of the *Seismische Registrierungen* contains the records for part of 1904 and for the interval April 1908–1913. Since then, the numbers have been published annually. We have recently received the sixteenth number, that for the year 1928, compiled by Dr. G. van Dijk, the director of the seismological section. It contains the records of

433 earthquakes, giving, as usual, the epoch, period, and amplitude of the various phases, and, with very few exceptions, the approximate position of the origin

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Two chief assistants in the department of psychological medicine of St Thomas's Hospital—The Secretary and Clerk to the Governors, St Thomas's Hospital, S E 1 (June 30) A labour superintendent at the ordnance factories of the Royal Arsenal, Woolwich, with workshop training in an engineering establishment—The Under Secretary of State (C 5), War Office, S W 1 (July 3) A Sir Ernest Cassel reader in commerce at the London School of Economics—The Academic Registrar, University of London, S W 7 (July 6) A lecturer in agriculture under the Hertfordshire County Council—The Clerk of the Hertfordshire County Council, 28 Castle Street, Hertford (July 7) A head of the engineering department, a lecturer in mechanical engineering and drawing and a graduate lecturer in electrical engineering (with physics and mathematics as subsidiary subjects) in the engineering department of the Merchant Venturers' Technical College, Bristol, also a head of the building department, a lecturer in building construction and building subjects, and a graduate lecturer in chemistry and physics (with mathematics as subsidiary subject) in the building department of the Merchant Venturers' Technical College, Bristol—The Superintendent, Merchant Venturers' Technical College, Bristol (July 7) A full time lecturer to take charge of the electrical engineering department of the Chesterfield Technical College—The Principal, Technical College, Chesterfield (July 11) A pathologist at the National Hospital for Diseases of the Heart—The Secretary, National Hospital for Diseases of the Heart, Westmoreland Street, W 1 (July 11) An assistant master, to teach mainly science subjects in the junior technical school and engineering departments of the Bolton Municipal Technical College—The Director of Education, Education Offices, Nelson Square, Bolton (July 11) A lecturer in chemistry at the Technical College, Sunderland—The Chief Education Officer, 15 John Street, Sunderland (July 11) An assistant lecturer in physics in the University College of Wales, Aberystwyth—The Secretary, University College of Wales, Aberystwyth (July 11) A lecturer in philosophy at Jesus College, Oxford—The Principal, Jesus College, Oxford (July 11) A lecturer in physics at the Northampton Polytechnic Institute—The Principal Northampton Polytechnic Institute, St John Street, E C 1 (July 13) An assistant lecturer in physics at University College, London—The Secretary, University College, Gower Street, W C 1 (July 13) An assistant lecturer in chemistry in the University of Sheffield—The Registrar, University, Sheffield (July 13) A demonstrator in civil engineering and surveying at the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, S W 7 (July 15) A woman professor of mathematics at the Huguenot University College, Wellington South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W C 2 (July 31) A Savilian professor of astronomy in the University of Oxford—The Registrar, Old Clarendon Buildings, Oxford (Oct 10) A director of research of the British Launderers' Research Association—The Secretary, British Launderers' Research Association, 17 Lancaster Gate, W 2

Our Astronomical Column

Tempel's Comet 1866 I —This is the comet associated with the November meteors, it has a period of about 33 years, but was not recovered at its return in 1899 In the hope of facilitating its recovery at the forthcoming return, the computing section of the British Astronomical Association undertook the computation of the perturbations from 1366 (when a comet, believed to be the same, was observed) to 1866 and onward to 1933, the results are published in the April number of the *Journal* of the Association, and were supplemented by a further statement at the meeting on May 27 The deduced orbit for the next return is found to be nearer the earth's orbit by half a million miles than it was in 1899, which gives hopes of a better display of meteors The most hopeful dates for meteors are 1932 Nov 16 5 and 1933 Dec 16 8, but search should also be made on 1931 Nov 17 3

The first rough date announced for the comet's perihelion passage was 1933 May 4, but revision of the work has made this some three months earlier, or the end of January, in 1866 perihelion was on Jan 11, so if the date is only slightly later than this, there will be good hope of observing the comet There is still uncertainty of a month or more either way in the predicted date, but before the investigation the uncertainty was quite two years, so that it has been notably reduced The recovery of the comet is highly desirable, it would make possible the accurate study of its motion in the past, and would verify, or otherwise, the conjecture of Le Verrier that the comet and meteors owed their introduction into their present orbit to the action of Uranus in A D 126 Some textbooks refer to this conjecture as an established fact, but it is not so, however, the near approach of the comet's orbit to that of Uranus makes it likely that there was a close appulse of the two bodies at some epoch

The Distance of the Galactic Centre —*Astr Jour*, No 957, contains articles by P van de Kamp on the distance of the galactic centre and the thickness of the galactic absorbing layer He notes that the existence of this layer, first announced by Trumpler, has been further confirmed by Schalen, Ohman, Miss Slocum, and himself Hubble's work on the spiral nebulæ gives further support, as he finds an irregular zone of avoidance of such nebulæ along the Milky Way, while their distribution elsewhere is fairly uniform The thickness of the layer is given as 210 parsecs, with a probable error of 40

The distance of the centre of the galaxy is found from (1) the centre of the system of globular clusters, (2) from a study of cluster type variables in a Milky Way field, (3) from the constants of galactic rotation The extreme values of the distance of the centre in parsecs are 16,700 and 7000 He suggests 12,000 as a mean (say 40,000 light years) This implies an absorption intermediate between Trumpler's value and that of Bottlinger and Schneller, it would be somewhat over a magnitude at 1000 parsecs

Research Items.

An Aboriginal Tasmanian Skeleton.—In *Man* for June, Mr. Gilbert Rigg describes human bones forming part of a skeleton, which was found in a shelter at the head of the Mersey river. The skull lacks the lower jaw and the incisors and canines of the upper. The bones show considerable weathering and are stained a light to dark brown. The specimen is a male, judging from the pelvis; and the teeth are greatly worn on the crowns, so that it would appear that he was not a young man. The sutures of the skull are unclosed. He was, therefore, probably under middle age. The teeth show no sign of caries, but an abscess has corroded the roots of the first and second molars on the right and has eaten well into the jaw. The wear of the teeth is partly due to the nature of the food, which included a large proportion of shell fish. Sand doubtless found its way into the food. The principal measurements of the skull are: *Max. length*, glabella to occiput, 185.5 mm.; *Width*, across parietal bones, 135 mm.; across temporal lines, 97.5 mm.; *Max. zygomatic width*, 134 mm.; *Height*, above earholes, 116 mm.; *Cephalic Index* 72.8; *Cranial capacity* (Pearson and Lee's formula), 1368 c.c.; (shot) 1340 c.c.; *Palatal width*, across the outer borders of the second molars, 69.8 mm.; length (by estimate) 63.3 mm. The measurements bring out the great size of the teeth, a characteristic of Tasmanian aboriginals. Among the other bones the atlas is present and six dorsal and lumbar vertebræ. One scapula only is present, the left, and only the right humerus. The left half of the pelvis is missing. Both femora are present, but only one tibia.

The Hares of Japan.—Yoshio Abe has followed up his researches upon the seasonal changes of colour in the variable hare of Japan by making a systematic study of the species. He regards it as differing from any of the northern varying hares and designates it a new variety, *Lepus brachyurus etigo* (*Jour. Sci. Hiroshima University*, Ser. B, Zoology, March 1931). The mixture of elements which make up the present fauna of Japan, derived partly from Saghalien in the north and partly from Japanese-Corean forms and more southern forms, travellers across former land bridges, makes the resolution of the hare species no easy matter, and Abe is inclined to differ on several points from previous workers. He recognises nine Japanese species and races, and in addition to the Etigo hare mentioned above, describes as a new race of the variable hare, the Saghalien hare *Lepus timidus saghaliensis*.

Ancestral Peculiarities in Lower Jaw of Elephant.—In the course of a detailed examination of the anatomy of three fœtal elephants, Dr. Nellie B. Eales has found, in the form and set of the mandible, traces of an ancestral character (*Proc. Zoo. Soc. Lond.*, April 1931). In an adult elephant, the mandible is deflected and the pre-alveolar border is useless, a unique condition. In the fœtal specimen examined, however, the deflection was greater than in adults, and the mandibles were of longirostrine type, in this respect suggesting some of the extinct forms of proboscidians. During early post-natal development, the jaws shorten, and gradually become like those of their parents. Dr. Eales looks upon the modification as an embryonic repetition of the phylogeny of the race.

Birds of Hispaniola.—In an account of the "Birds of Haiti and the Dominican Republic", Alexander Wetmore and Bradshaw H. Swales discuss the most interesting avifauna in the West Indies; for the island of Hispaniola, so named by Columbus on its discovery, has preserved in its high mountainous tracks remnants of an ancient fauna which has elsewhere disappeared in the archipelago (*U.S. Nat. Museum Bull.* 155, 1931). Though the island has from time to time yielded many peculiar forms, it is only within recent years that the significance of the fauna as a key to the problems of distribution in the Antilles has been understood. The resident forms fall into two principal groups, one of species found on the coastal plain or foot hills of the interior, and the other a much smaller body confined to the high mountains of the interior. The former series contains members which range at large over the entire main island and may extend even through the adjacent Greater Antillean islands. It has a few peculiar species, elsewhere unknown, like the flat-billed vireo (*Lawrencia nana*) and the palm chat (*Dulus dominicus*). The high mountain series, including such as the cross-bill (*Loxia megaplaga*), several thrushes, a warbler, and others, are highly peculiar in occurrence and seem to represent remnants of an ancient fauna of general distribution, which has since disappeared except on the mountain ranges of the island, the most extensive area of elevated land in the West Indies.

Kidney Worm of Pigs.—I. Clunies Ross (*Jour. Council Sci. Ind. Res. Commonwealth Australia*, vol. 4, No. 1) records observations on *Stephanurus dentatus*, the kidney worm of pigs, which is found when mature in small fibrous capsules opening into the pelvis of the kidney, while larval stages and immature adults are found also in the liver, lungs, thoracic cavity and sub-lumbar muscles. This parasite is firmly established in the north-east coastal region of Australia but is scarce south of Sydney. The eggs of the worm pass out with the urine and hatch in a minimum period of 16 to 24 hours. The microscopic larvæ develop in mud, and in about five days, having undergone two ecdyses, are able to infest pigs. They may survive for five months under suitable conditions of heat and moisture. The larvæ may be swallowed by the pig or may enter through its skin (this is confirmed by Dr. Kauzal), and in either case reach the liver, where they grow rapidly while wandering in the liver tissue and causing great destruction thereof. Only after five or six months' development do the worms, now adult but immature, take up their final position in the vicinity of the kidney or ureter, where their presence gives rise to the formation of the fibrous sacs in which the male and female worms are found. The author points out that in well-drained and clean sites or in sanitary yards it is possible to decrease the danger of infestation and even to effect complete eradication of the worm.

Notes on Ostracods.—Mr. A. G. Lowndes, in his paper "Some Rare and Little Known British Freshwater Ostracods", published in the last Report of the Marlborough College Natural History Society (No. 79), records a number of species of ostracods, mostly from the Marlborough district, two of which are new to the British Isles. Detailed descriptions are given, and the paper is illustrated by microphotographs and by line drawings. In a second paper by the same author, "On Entomostraca from the New Hebrides collected by Dr. J. R. Baker", (*Proceedings* of the Zoological Society of London, 1930, published January 1931), some interesting observations are made, especially on the ostracod *Stenocypris malcomsoni* Brady, well known from tropical countries. The material is from a large lake on the island of

Gaua, two samples of dried mud also being collected, from one of which, taken in shallow water, a good culture of *Stenocypris* was obtained. The male is unknown and all the culture specimens obtained were from parthenogenetic females. A good deal of variation is found among the individuals in a culture, especially in the armature of the caudal furca, and good figures are given showing the differences.

Eradication of Prickly Pear in South Africa.—Although not yet such serious pests as they have proved in Australia, various species of *Opuntia*, indigenous to America and possibly introduced in the first place in cultivation, are now spreading in South Africa. C. R. van der Merwe, in *Science Bulletin* No. 93, issued by the Department of South Africa, gives some account of the spread of these species in the Cape Province particularly, and discusses possible methods of eradication, in the light of the extensive Australian experiments in this direction at the Dulacca Prickly Pear Experiment Station and of recent South African experiments at Uitenhage, which have been designed to test Australian methods under South African conditions and against the species particularly rampant in South Africa. These, which are described, are given as *O. monacantha*, *O. maxima*, *O. megacantha*, and *O. aurantiaca*. Where dense stands of prickly pear are encountered, it is concluded that the methods of eradication which seem most effective require a combination of spraying and injection with soluble arsenical compounds.

Electricity in Horticulture.—Electricity is at present little used in horticulture, but since market gardening is usually carried out on intensive lines and in concentrated areas, there seem better prospects of its proving an asset in this industry than in farming. In a recent article (*Jour. Min. Agric.*, 38, p. 132), C. A. Cameron Brown shows that a considerable amount of experimental work on this question is being undertaken, some of which seems suitable for development on a large scale. Electricity as a source of bottom heat appears to be particularly promising. Electric hot beds are already employed successfully on the Continent, and it is not improbable that an extension of this system would lead eventually to some replacement of the usual manure hot bed with its obvious disadvantages. The investigations regarding the use of power for cultivation, and electric light for increasing plant growth are less far advanced. Various cultivation implements have been designed, notably in France, but their cost of production is at present too high to merit their use on a commercial scale. Extension of the length of day by artificial lighting has been definitely shown to improve the growth of plants, but more experiments are required before it is certain that such treatment can be considered an economic proposition.

New Zealand Glaciation.—A report on evidences of past glaciation in New Zealand and Australia by Dr. P. Marshall is given in the *Report* of the twentieth meeting of the Australian and New Zealand Association for the Advancement of Science (Brisbane, 1931). The work was the result of a research committee appointed at the previous meeting. There is held to be no evidence of Silurian or of any other glaciation previous to the considerable extension of the present glaciers in late Pleistocene to recent times. Even that extension would appear to be of much smaller extent than was previously supposed. Large accumulations of gravels in several areas in Central Otago are now ascribed to fluviatile origin previous to the development of glaciation. In the North Island there seems to have been no glacial development on the high volcanoes or on the central mountains from Cape Runaway to Cook Strait. The report also summarises the evidence for glaciation in Cretaceous times in New South Wales and in Permo-Carboniferous times in Western Australia and Victoria.

The Structure of Incandescent Carbon.—In a recent *Scientific Paper* (No. 299) from the Tokyo Institute of Physical and Chemical Research, M. Hirata has given an account of an X-ray study of carbon. The specimens were mounted as poles of an arc, and the X-ray diffraction patterns produced by them photographed both with no current passing and with the carbons kept incandescent by having the arc burning. The main object was to find if the surface of either pole became liquid at the high temperatures reached (4000° C.), but although part of the pattern due to the position pole could be accounted for in this way, the results were inconclusive. From the change in *spacing of the diffraction rings between room temperature* and incandescence, it has been shown that the expansion of the graphite occurs almost completely in a direction perpendicular to the most closely packed plane, the average value of the expansion coefficient being $4 \cdot 10^{-5}$ per degree, which is much larger than the expansion coefficient at lower temperatures.

The Electrical Failure of Crystals.—It is known that if potential surges of short duration are applied to crystals discharge tracks appear in the solid which are not unlike Lichtenberg figures in form, and follow definite crystal axes. The extension of these observations to the practical case of failure of crystals under prolonged electric stress is described by J. Lasz in the *Zeitschrift für Physik* for May 12. Asymmetrical fields were applied between point and plane electrodes in rock salt, fluorspar, gypsum, and calcspar. When the temperature was not too high the channel formed by the spark followed directions defined by the crystal axes, being usually built up of a number of straight sections, and not following the shortest line from point to plane; when a track forked, each branch made its own channel on similar lines. The effect of the spark appeared to consist in a plastic deformation of its immediate neighbourhood, followed later by local shattering and fusion. At higher temperature the directing effect of the crystal axes disappeared and the spark passed in the region of greatest field strength. It is remarkable that the average field needed for the disruptive discharge is much smaller than has been calculated theoretically by Rogowski.

Rare Earth Metal Amalgams.—Of the sixteen rare earth metals, only six have been obtained in the free state (Y, Ce, La, Nd, Sm, Eu), and only two (Ce, La) in a high state of purity. Audrieth, Jukkola, and Meints, working in collaboration with Prof. Hopkins, of Illinois, describe some interesting experiments in the May number of the *Journal of the American Chemical Society* which show that it is possible to prepare rare earth amalgams electrolytically not only from aqueous but also from absolute alcoholic solutions. The paper deals with the amalgams of lanthanum and neodymium; work on other amalgams, and the separation of the metals from them, is contemplated. The amalgams are extremely reactive and undergo ready decomposition. By heating the neodymium amalgam in vacuo much of the mercury was removed, but some remained even at the temperature at which pyrex glass begins to melt. The product thus obtained was a black powder which readily takes fire in air. By heating this powder in a tungsten boat in a high vacuum furnace the remaining mercury was eliminated, and the neodymium metal could even be volatilised with the deposition of an extremely reactive film of the element.

Canadian Coal

By a Canadian Correspondent *

AMONG the most abundant of Canada's natural resources, coal is near the head of the list A comparatively recent estimate placed the coal reserves of the Dominion at more than 1,234,000,000,000 metric tons, or about 16 per cent of the world's coal reserves

The principal coalfields of Canada are in Nova Scotia, Alberta, and British Columbia, while the chief centres of industry and population are in Ontario and Quebec 2000 miles to the east and 1000 miles to the west The great coalfields of the eastern United States lie only 300 500 miles to the south of the southern boundaries of Ontario and Quebec, and from those fields these two provinces import most of their coal, because it is more economical to do so For the past thirty years Canada has imported from 50 to 60 per cent of its total coal requirements from the United States

Ever since Confederation in 1867, it has been the aim of every government to make it possible for Canadian mines to obtain a larger proportion of the total coal business Until recently, efforts in this direction have been confined to the imposition of protective tariffs, but lately this has been supplemented by more direct forms of assistance, such as by the Dominion Government paying a share of the freight rates on coal from western and eastern mines in Canada to points in Ontario, Quebec, and Manitoba, also by extending some monetary aid under the Domestic Fuel Act of 1927 to by product coking plants

Nine years ago, an organisation known as the Dominion Fuel Board came into being by government regulation It was formed to make a thorough study of the underlying causes of recurring coal shortages and of the methods by which they might be counteracted Since then the Board has been largely instrumental in stimulating the provision of fuels alternative to American coal for Ontario and Quebec, and is chiefly responsible for the greatly increased importations of British anthracite in the last three years

Of the Canadian coal production in 1930, amounting to 14,799,000 tons, less than 750,000 tons was exported, and it does not appear that there is much likelihood of the export market being increased The possibility of extending the home market by supplanting American coal with the Canadian product has been engaging the attention of the Fuel Board To the end of 1930, government assistance in the form of subventions and the operation of the Dominion Fuel Act have resulted in the placing of 900,000 tons of Canadian coal and coke in markets previously held by foreign coal

The character of the mining problems presented in the coalfields of the maritime Provinces indicates that the present production of between six and seven million tons cannot be increased more than perhaps 50 per cent above present figures If this were accomplished, the total production of these fields would still fall short of supplying the present requirements of Canada, east of Ottawa and Kingston, by from one to two million tons per annum

At the present time, maritime coals supply approximately seven million tons out of a total consumption of eleven and a half million tons It is evident, therefore, that eastern Canada must look to other countries for a considerable part of its needs

In the west, the capacity of existing mines is far in excess of present needs Total requirements of the western provinces are about ten and a quarter million tons About half a million tons are imported from the United States, chiefly to Manitoba British Columbia in past times had a good export market to California, but this has diminished greatly. Total exports of Canadian coal from the western fields are now only about 400,000 tons

The lack of coal resources in Ontario and Quebec has been compensated to a large degree by the development of the abundant water powers of these provinces There is now approximately six million horse power developed In terms of coal, this is the equivalent of eighteen million tons, an amount more than the total Canadian coal production

The use of fuel oil is increasing rapidly In 1929 the latest year for which complete figures are as yet available, the total consumption of fuel oil in the Dominion outside the refineries was more than 413,000,000 gallons—an 18 per cent increase over 1928 The consumption of fuel oil in 1930 is expected to show a small increase The coal equivalent of the present consumption is approximately three million tons The competition of fuel oil is being particularly keenly felt in British Columbia coal mines Cheap oils from California and Peru have replaced nearly one million tons of coal in British Columbia The bulk of this oil is used by the railways

In 1930, Canada imported 17,728,991 tons of coal, of which 13,463,601 were bituminous and 4,265,390 anthracite Of the total imports of bituminous coal, 13,217,369 tons were from the United States and 146,232 tons from Great Britain Of the anthracite imported, 2,965,254 tons were from the United States, 996,127 from Great Britain, 292,529 from Russia, and 11,480 from Germany

Last year, Canada consumed 31,870 tons of coal and 3,385,000 tons of coke—a decrease of 3,000,000 tons from the average consumption of the previous two years Central Ontario consumed approximately thirteen million tons, Quebec five millions, Alberta four and a half millions, and Nova Scotia three and three quarter millions

Of the total Canadian coal production last year, the mines in Nova Scotia accounted for 6,247,761 tons, New Brunswick, 208,405, Saskatchewan, 571,632, Alberta, 5,682,487, and British Columbia, 2,089,052, a total of 14,799,337 tons valued at £10,600,000 The coal mining industry in Canada represented at the end of 1929 a capital investment of £28,400,000 There were at that time 29,739 employés in the industry, whose salaries and wages bill totalled for the year £8,475,000, or about £285 per employé

As a step towards the more economical utilisation of domestic fuel supplies, pamphlets have been published dealing with the advantages to be gained through proper insulation of houses and factories, and the maintenance of adequate humidity in them The question of proper humidity in houses subject to a Canadian winter climate is one which closely affects standards of health as well as fuel economy, and investigations on these subjects are being continued

Canadians are fully aware of the advantages to be gained through the development of a national fuel policy, which will assure to them the fullest possible use of their own fuel resources consistent with reasonable economy in the distribution of them Where factors of transportation prohibit the realisation of this aim, effort is concentrated in finding a source of supply within the British Empire That these aims have met with a measure of success is evidenced by the increasing imports from Great Britain

* This article is based upon information derived from various official documents and the records of the Department of Mines, Ottawa

Annual Assembly at Rothamsted Experimental Station.

THE annual assembly of subscribers to the Rothamsted Experimental Station took place on June 18, when demonstrations of the field experiments and of the work going on in the various laboratories were given As the time available for the inspection of the fields was short, only a limited number of the trials were inspected, these included the classical experiments on the Park Grass begun in 1856, and the one on the famous Broadbalk wheat field started in 1843 The first was designed to show the effect of different fertiliser treatments on the yield and character of the herbage, and to-day it forms a very striking illustration of the way in which the farmer can affect the nature of his pasture by varying the plant nutrients supplied The second experiment was originally intended to show the effect of nitrogen, potash, and phosphorus on the growth of the wheat plant, the action of these three substances is now well known, but the experiment is still yielding valuable information for example, a few years ago a study of the yields from the various plots, with the weather records, enabled the statistical department of the station to deduce valuable correlations between rainfall at different seasons of the year and the yield More recently, by studying the average yield of the plots, the physics department has been led to the study of certain soil characteristics

The average yield of the plot receiving a full annual dressing of artificial manure has been very close to that of the plot receiving farmyard manure, but the economic value of the two crops has not been equal, since the dunged plot has yielded relatively more in unfavourable seasons, when prices were higher It is a matter of great importance to discover why the yields on the dunged plot have been less at the mercy of the vagaries of our climate The increased microbiological activity induced by the addition of organic matter is undoubtedly the primary reason, and it influences the yield partly by the production of soluble chemical nutrients and partly through the formation of humus, which gives a more open structure to the soil and, incidentally, gives it the black colour characteristic of a 'rich' soil The problem of ascertaining just how the presence of humic matter affects yields is bound up with the wider question of how the nature of the soil and the cultivation treatment it receives influences the growth of the crop and its response to manuring Work, therefore, on the stability of soil crumbs formed in the field under different systems of cultivation, and by sheep treading, is being followed up in the laboratory, where an attempt is being made to discover the nature of the forces which bind soil particles together The prosecution of this inquiry has involved excursions into pure science, particularly colloid physics and physical chemistry

These problems are part of the general one of land utilisation In many soil surveys only qualitative tests have been applied, owing to the large amount of time and money needed in using the existing laboratory methods Several new ways of determining the physical properties of a soil have been worked out at Rothamsted These are quantitative and, at the same time, very rapid In their development the needs of those responsible for irrigation projects in salty areas have been particularly kept in view

In addition, however, to the old classical experiments, more modern ones, designed to meet the needs of modern agricultural conditions, have been devised As an example, the six course rotation in Long Hoos field and the forage crop in Little Hoos may be cited

The main object of the six-course rotation is to obtain data by means of which the influence of climatic conditions in different seasons on the response of crop yield to artificial fertilisers may be studied The rotation is barley, clover, hay, wheat, potatoes, a forage mixture (rye, beans, and vetches) and sugar beet, and each crop is grown every year Sulphate of ammonia, superphosphate, and muriate of potash are used, and there is a range of five intensities of manuring for each fertiliser

The nature of the problems to be investigated in these experiments necessitates continuance over a long period of years, but the immediate results will be of interest A feature of the experiment is that the number of years required for a cycle of crops differs from the number required for a cycle of manurial treatments, so that the defect from which older rotation experiments suffered, that the same crop constantly recurred with the same manurial treatment on the same plot throughout the period of experiment, is avoided It is thus possible to eliminate the effects of permanent differences in fertility between the plots

The large experiment of 144 plots, arranged as a Latin square, in Little Hoos field is designed to investigate the effect of different fertilisers on the yield and chemical composition of forage crops consisting of mixtures of cereals and legumes The manuring of such crops presents difficulties which are not encountered when a single crop is grown, since the ability of one constituent to compete with the others in the mixture may be altered by manuring, and the composition and nutritive value of the produce so changed The main problem is to discover by what system of treatment with artificial fertilisers the yield of protein per acre may be increased Four different mixtures are used, consisting of winter oats, vetches, beans, wheat, vetches, beans, winter oats, peas, beans, and wheat, peas, beans The twelve fertiliser treatments include sulphate of ammonia, nitrate of soda, potassium chloride, and superphosphate, separately and in combination

Chemical investigations are being carried out on these crops, which should yield interesting information In 1930 ammonium sulphate increased the amount of cereal straw and depressed that of leguminous plants in mixed forage crops to such an extent that the large increase in total yield was not accompanied by any increase in the yield of protein per acre Calcium cyanamide generally gives similar results to ammonium sulphate, but under less favourable soil conditions it interferes with the normal nitrification process

In the afternoon the laboratories were inspected In the bacteriology department, the investigations made on the nitrogen fixing bacteria forming nodules on lucerne were explained In the past this work has led to a large increase in the area of ground on which lucerne can be grown, and special attention is being paid to the reaction of the organism to the host plant This is usually one of mutual benefit, the plant supplying the bacteria with carbohydrates, and receiving in return a supply of nitrogen compounds If the supply of carbohydrates to the nodule is checked, as by growing the plant in the dark, the bacteria become actively parasitic and destroy the cells of the host

The entry of the bacteria into the root is in some way assisted by root secretions of the host plant, although the manner in which these act is still uncertain

In the chemistry department, the barley crop is studied in great detail, because its value varies more strikingly than that of any other farm crop with the

conditions of growth The amounts of the principal nitrogenous constituents are closely related to the nitrogen contents for a given variety of barley, irrespective of the soil, season, and manuring Further, many of the properties recognised as important in brewing may be deduced from simple analyses on the original barley, and it should therefore soon become possible to place the valuation of barleys on a more rigid and objective basis In the course of the work, a successful laboratory technique for small-scale brewings has been developed

Interesting exhibits were shown by the department of mycology, illustrating racial differentiation and behaviour in fungal species, 'immune' potato varieties infected with wart disease, and the relation of fungal and host nutrition to potato diseases There were also demonstrations of the structure and life history of *Bacterium malvaccarum* and cotton plants growing in chambers under controlled environmental conditions In the Empire Marketing Board virus glass houses, plants were exhibited showing different types of virus diseases, and the physiological, cytological, and entomological aspects of virus research were shown

In the entomology department, the exhibits illustrated the means of control of Cecidomyidæ (gall midges) affecting osier willows, clover, wheat, and other plants, and experiments dealing with the chemotrophic responses of these insects and the extent to which they govern the selection of the host plants The field trials and laboratory observations designed to determine the amount of natural destruction exercised by parasites upon the frit fly and other agricultural pests were also demonstrated

The demonstrations gave the visitors some idea of the scope of the work carried on at Rothamsted, although the time at their disposal precluded an exhaustive tour of the fields and the laboratories

University and Educational Intelligence

BELFAST - The Senate has appointed Dr T Thomson Flynn to the chair of zoology from Oct 1, 1931 Dr Flynn is at present Ralston professor of biology in the University of Tasmania

CAMBRIDGE - The Vice Chancellor gives notice that the Quick professorship of biology will become vacant on Nov 1 by the retirement of Dr Nuttall A meeting of the electors will be held on July 17 The regulations provide *inter alia* that it shall be the duty of the Professor to devote himself to the study of the biology of the cell and generally to promote that branch of science by research and by the superintendence of a laboratory and otherwise Candidates are requested to send in their applications to the Vice Chancellor on or before July 10

The Council of the Senate has put forward recommendations for the three John Humphrey Plummer professorships The chairs are those of mathematical physics, inorganic chemistry, and colloid science

In the case of the chair of mathematical physics, it is recommended that it shall be the duty of the professor to promote the study of theoretical physics in connexion with the Department of Physics and the Faculty of Mathematics, with special responsibilities towards research students in the Department of Physics At the first election, preference shall be given to candidates whose work is connected with atomic physics Before each election to the professorship after the first, the General Board shall consult the Council of the School of the Physical Sciences as to the needs of teaching and research in theoretical physics, particularly in connexion with the Department of Physics, and, if the Board think fit, it shall be specified in the notice to candidates that preference will be given to those whose work is connected with some particular branch or branches of theoretical physics

Mr W H Mills, Jesus College, has been elected reader in stereo chemistry

GLASGOW —The honorary degree of LL D. was conferred on Sir F G Hopkins, president of the Royal Society, and on Prof. C U Ariëns Kappers, professor at the Central Institute for Brain Research, Amsterdam, at the graduation ceremony held on June 17 At the same graduation, the degree of D Sc was conferred on Dr G W Tyrrell for a thesis entitled "The Geology of Arran"

LONDON —Prof W W Jameson, professor of public health in the London School of Hygiene and Tropical Medicine, has been appointed dean of the School, in succession to the late director, Sir Andrew Balfour

The following appointments to University Chairs have been made by the Senate Philosophy (King's College), Dr H F Hallett, since 1919 lecturer in philosophy in the University of Leeds, Medical Industrial Psychology (London School of Hygiene and Tropical Medicine), Dr Millais Culpin

The title of Reader has been conferred upon Mr Sydney Barratt, physical chemistry, University College, Dr L F Bates, physics, University College, and Dr E A Spaul, zoology, Birkbeck College

University postgraduate travelling studentships of the value of £275 for one year have been awarded to John Stuart Anderson and Eric Gwynne Jones Mr Anderson proposes to continue research in the chemistry of the metal carbonyl compounds and related substances at Heidelberg Mr Jones proposes to carry on spectroscopic research at the astrophysical observatory at Potsdam

OXFORD —Applications are invited from members of Magdalen College for the Edward Chapman research prize value £20, for a published piece of original research in physics or chemistry, including the sciences of astronomy, meteorology, mineralogy and geology, zoology and botany, treated from the morphological, palæontological, physiological, or pathological point of view Further particulars are obtainable from Prof H L Bowman, Magdalen College Competing essays must be received by, at latest, Oct 10

THE Foreign Work Committee of Leplay House announces that during the coming August vacation there will be a visit to Poland, including a fortnight in the Carpathians and a few days in Poznan, Cracow, and Warsaw, for historical, geographical, and sociological studies The studies will be under the direction of Mr R E Dickenson A meeting will also be held in the Cantal, with Rocamadour and Le Lioran as the centres, under the direction of Mr D L Linton A students' camp will be held in Yugoslavia Full particulars may be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S W 1

THE tenth Unity History School will be held this year in Stockholm, under the direction of Mr F S Marvin The general subject will be "The World at Peace A Survey of Post-War Developments" Both English and Swedish lecturers will be taking part, among them being Prof Herbert Dingle, of the Imperial College of Science, who will trace recent progress in the physical sciences; Mr. Hartley Withers, who will deal with financial and economic problems, Mr Unden, rector of Uppsala and ex-Minister of Foreign Affairs, on international law, and Archbishop Söderblom, to whom the Nobel

Peace Prize was recently awarded The date of departure from London is Aug 5 Full particulars can be obtained from the Hon Secretary, Mrs Innes, 29 High Oaks Road, Welwyn Garden City

Birthdays and Research Centres

June 29, 1868 —Dr G E HALE, For Mem R S, honorary director of the Mount Wilson Observatory, Pasadena, California

The spectrohelioscope, spectroheliograph, and spectrograph of my solar laboratory are being used in several combinations for visual and photographic observations of the atmosphere and magnetic fields of the sun A standard form of spectrohelioscope will soon be in operation at twenty five or more observatories distributed around the earth A plan of co-operative research will deal primarily with the question whether auroræ, magnetic storms, and other geophysical phenomena are caused by solar eruptions, as certain observations and theories suggest

The Astrophysical Observatory and Laboratory of the California Institute, conducted in close co operation with the Mount Wilson Observatory, are in process of development Experiments in manufacturing large mirror discs for the 200 inch telescope are under way, with good prospects of ultimate success New auxiliary instruments, including correcting lenses, spectrograph objectives, and radiometers, when tested with the 60 inch and 100-inch reflectors on Mount Wilson, have greatly increased the efficiency and range of these telescopes

June 29, 1885 —Prof W C MCCULLAGH LEWIS, F R S, professor of physical chemistry in the University of Liverpool

The work which has been carried out for some years now in this laboratory belongs, in the main, to the field of bio colloid chemistry, a branch of chemistry which is receiving considerable attention in various research centres So far as our own programme is concerned, it may be said to include four lines of investigation (1) The kinetics and energetics of coagulation or aggregation of typical colloid and other finely dispersed systems, (2) the physico-chemical aspects of denaturation of proteins, (3) the capillary behaviour of finely dispersed systems of biochemical importance, for example, the lipoids and proteins, (4) the kinetics and energetics of enzyme processes In addition to the bio-colloid work, research in photo chemistry and electro chemistry is likewise being carried out by members of the staff

July 2, 1862 —SIR WILLIAM BRAGG, O M, K B E, F.R S, director of the Royal Institution of Great Britain

The determination of the crystal structure of organic substances is the chief object of research of my colleagues and myself in the Davy Faraday Laboratory Our particular object for the moment is the improvement of the apparatus and of the interpretation of the results It seems that advance in the future will depend on observations of the relative intensities of the pencils of X rays diffracted by a crystal. The crystals to be examined are generally very small, weighing only a fraction of a milligram We have therefore been constructing powerful X-ray tubes which should give results plainly, accurately, and quickly

At the same time various interesting crystals are under examination, and, in particular, the long chain compounds. The new X-ray tubes make it easy to observe certain remarkable effects as the substances are heated until they melt

Societies and Academies.

LONDON

Royal Meteorological Society, June 17 —**S Chapman** A theory of upper atmospheric ozone The paper consists of a discussion of the daily and annual variations of the ozone content of the atmosphere in any latitude up to about 50° The ozone is treated as if it were uniformly spread through a layer of air 10 km thick, having the same density as the air at the level of maximum ozone density Convection and diffusion of ozone are neglected The thermal decomposition of ozone ($2O_3 = 3O_2$) is discussed, and estimated to be negligible, except possibly in connexion with an eleven year (sunspot) variation of ozone —**C K M Douglas** On the relation between temperature and pressure in the troposphere It is shown that the high correlation coefficients between pressure and temperature high up in the troposphere are closely related to the constancy of the lapse rate of temperature The correlations between the mean temperature of the column up to 9 km and the temperatures at 3 and 6 km are very high Some factors tending to produce a constant lapse rate are discussed Groups of extreme cases show that when the barometer at sea level is very low or very high the troposphere contributes about half the deviation from the mean Both cyclones and anticyclones can be grouped into systems largely confined to the troposphere, and systems extending to the stratosphere The argument in favour of an advectional theory is developed

PARIS

Academy of Sciences, May 4 — **A Cotton** The optical properties of a liquid placed in a magnetic field and traversed by a beam polarised in any direction Remarks concerning the work of G Dupouy and M Schérer, with special reference to the installation —**Charles Nicolle** Distemper in dogs can be experimentally transmitted to man without apparent symptoms Although man can act as a carrier of the distemper virus, no reaction of temperature or otherwise could be detected —**A Fraenkel** An essential alternation of the axiom of choice —**W Tartakowsky** The totality of numbers representable by a general quadratic or cubic indefinite form —**Mandelbrojt** Functions, holomorph and limited in a semi plane —**Henri Cartan** A remarkable class of domains —**M Pichot** and **P Dupin** The distribution of the velocities of colloidal solutions presenting anomalies of viscosity The flow of water and of a 0 7 per cent gelatine solution between parallel planes has been studied by the Camichel chronophotographic method, and curves are given showing the velocity as a function of the distance from the walls for each of these liquids These curves prove the existence of a central portion flowing *en bloc* in the case of the gelatine solution —**Henri Mineur** Remarks on the mechanics of variable masses —**E Huguenard** A method of mechanical inscription applicable to the recording and reproduction of sounds —**M Pauthenier** and **Mme M Moreau Hanot**: The cylindrical ionised field and the duration of the path of the ions —**V Dolejšek** The ultra-soft X-rays A modification of Osgood's method was used The most intense line obtained was a doublet with an approximate wavelength of 480° A —**G Dupouy** and **M Schérer** The combination of the simultaneous optical effects of magnetic rotary polarisation and magnetic double refraction in a liquid —**Jean Becquerel** and **Louis Matout** The combined effects of the internal electric field of a uniaxial crystal and of a magnetic field normal to the optic axis Variations of the

components of the absorption bands of the ordinary spectrum according to the relative orientations of the incident vibration, of the binary axes, and of the magnetic field Circular polarisation and magneto electric rotary power —**R Gibrat** The optics of uniaxial heterogeneous structures —**Guichard, Clausmann, Billon, and Lanthony** New data relating to the independence of the hardness and hydrogen content of electrolytic metals Reply to criticisms by L Guillet and J Cournot Fresh experimental evidence is given in support of the authors' views —**Augustin Boutaric and Maurice Doladilhe** The adsorption of colouring matters by the granules of a hydrosol —**Georges Fournier and Marcel Guillot** The absorption of the β rays by matter —**Mme Irène Curie** The complexity of the a radiation of radioactinium —**F Joliot** The phenomenon of recoil and the conservation of the quantity of motion The author has repeated Akiyama's experiment and has obtained similar phenomena, but considers unnecessary the hypothesis of an emission of a γ radiation of very great energy – **L Bert and R Annequin** The action of phosphorus pentachloride upon ω chlorallyl benzene derivatives The action of phosphorus pentachloride upon compounds of the type R C_6H_4 CH_2 CH CHCl furnishes a good method for obtaining C_6H_5 CH_2 CHCl $CHCl_2$ and its homologues —**Sébastien Tabetay** On ω ω' dichloroparaxylene, *p* diethylolbenzene, and *p* divinylbenzene —**Mlle M Montagne** The action of organomagnesium compounds on N diethylacetamide —**C Gaudefroy** The orientation of crystals, and of quartz in particular, with the aid of corrosion figures —**F Holweck and P Lejay** Improvements in a transportable instrument for the rapid measurement of gravity The portable type of instrument described and illustrated is an improved form of one described in an earlier communication After being carried 2000 kilometres in a motor car, without special precautions, its accuracy was unaffected —**Ladislas Gorczynski** Some measurements of the diffused solar radiation obtained with solarimeters in the Maritime Alps —**Chung-Hwang Chow** The development of the carpophore in *Coprinus tormentosus* —**M Bridel and R Lavieille** The sweet principle of the leaves of Kaá hê é (*Stevia Rebaudiana*) The dry leaves contain 6 per cent of the glucoside, stevioside This is very sweet, about 300 times as sweet as cane sugar It is not hydrolysed by emulsin, rhamnodiastase, yeast or by powdered *Aspergillus niger*, but 5 per cent sulphuric acid acting for three hours at 100° C gives a glucose and a substance, steviol —**F Fouraire** A new myxosporidium of the genus *Chloromyxum* observed in the carp —**P Lépine** The separation of the antagonistic sexual hormones in extracts of the anterior lobe of the hypophysis —**A. Leulier and B Drevon** The action of the blood serum on morphine chlorhydrate in the presence of hydrogen peroxide Oxydimorphine has been proved to be formed under these conditions – **Ch Dhéré and M Fontaine** The fluorescence spectra of the phycochromoproteids studied in solution and in a living alga —**J Magrou, Mme M Magrou, and E Roubaud** The stimulating action at a distance exercised by certain bacterial suspensions, through quartz, on the eclosion of the mosquito of yellow fever —**J Parrod** The formation of a-arabinotetroxybutyl 4-imidazol at a low temperature, starting with glucose and with levulose in a solution of ammoniacal cupric hydroxide —**Armand Dehorne** New observations on the generalised plasmodium and the merozoite cysts of *Sabellaria spinulosa* —**Ugo Lumbroso and Mlle. H. Van Sant** New strains of bacteria isolated from north African cases of trachoma following Noguchi's technique Three strains of bacteria have been isolated, A, B, and C. Of these, type A differ essentially from the *B granulosum* of Noguchi in the appearance of the colonies, their consistence, their golden yellow pigment, and the absence of fermenting power towards certain sugars attacked by *B granulosum* Type B, and especially type C, show still greater differences —**C Levaditi, J Bardet, A Tchakirian, and A Vaisman** *Gallium*, its therapeutic properties in syphilis and the experimental trypanosomiases *Gallium* has a marked preventive and curative action in syphilis and certain trypanosomiases

CAPE TOWN

Royal Society of South Africa, Mar 18 —**R A. Dart and Nino del Grande** The ancient iron smelting cavern at Mumbwa —**R S Adamson** On a new species of *Aristea* —**H Zwarenstein and I Schrire** The effect of castration upon protein metabolism Total castration of male rabbits leads to an increase in weight and to a 25 40 per cent increase in creatinine excretion 3 months after operation Grafting of testes caused a return to normal within a fortnight. The creatinine excretion of a female rabbit showed a 20 per cent decrease 3 months after removal of the ovaries —**M Fortes** Perceptual tests of general intelligence for international use —**Sir Thomas Muir** (*a*) Note on equalities connecting two sums of squares (*b*) Note on a special alternant of three variables —**J F V Phillips** A sketch of the floral regions of Tanganyika Territory

LENINGRAD

Academy of Sciences (*Comptes rendus*, No 18, 1930) — **N Zelinsky and M Rakuzin** A new simplified procedure for the manufacture of sulphuric acid from plaster of Paris Calcium sulphate can be converted, by boiling with ammonium carbonate, into ammonium sulphate and the latter electrolysed to produce sulphuric acid —**A Arkhangelskii and E Salmanson** : A note on the diagenesis of the marine argillaceous deposits The chemical side of the processes connected with the interaction of particles of soil and the sea water is discussed —**L Broude and V Gulevitch** The use of Buchner's press for the studie of animal extractive substances The press can be applied successfully in qualitative studies on extractive substances from muscles, but the amount of the extract is never complete and the method cannot be recommended for quantitative studies —**V Nikolaev and S Kosmann** On the boracic acid of the Tchokrak salt lake Analyses of the lake water —**N Achyeser** . (1) On certain polynoms of minimum deviation. (2) On the extremal proprieties of certain fractional functions

SYDNEY

Linnean Society of New South Wales, Mar 25 —**Germaine A Joplin** Petrology of the Hartley District. (1) The plutonic and associated rocks The plutonic rocks at Hartley occur as a portion of a large bathylith, and in two stocks, each of which is about one mile in diameter Hypabyssal rocks occur in the form of dykes and apophyses associated with the bathylith A number of different types, ranging from ultra-acid to ultra-basic, have been described, and mineralogical and chemical evidence points to consanguinity among them The complex forms a typical calcic, or sub-alkaline suite, and is comparable to one of similar age at Moruya It is probable th[illegible] the various types have been developed as a result fractional crystallisation in an intercrustal reserv[illegible] followed by separate injections of the fractio[illegible] differentiation *in situ* The plutonic rocks [illegible] trusive into Upper Devonian sediments, and a[illegible] lain by Permo-Carboniferous Upper Marine bed

I.I.H.R. Bangalore Centre:-

The centre is entrusted to work on Solanum Viarum Periwinkle, Rose geranium and Patchouli crops. The centre has also initiated studies on Jasminium grandiflorum exploration and domestication studies. It has developed a culture in Solanum viarrium (IIHH 24-II) under release for high density planting.

Extension Work:

Extension booklet and Phamphlets, on cultivation practices on Opium Poppy Palmarosa. Lemagran, Vetiver have been brought out . The centres have participated in Kisan Melas. Seed and planting material are also being distributed to farmers and enterprenure from all the centres . The scientists in co-ordination unit and at the Project station have given T.V. and Radio talks on cultivation and primary processing of these crops important out extention articles in popular Agriculture Journals during the year.

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